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# Revision of the Bee Genus *Agapostemon* (Hymenoptera: Halictidae)<sup>1,2</sup>

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## ABSTRACT

In this study 43 species of *Agapostemon* are recognized from the Americas. Of these, the following 19 species are new: *A. aenigma*, *A. alayoi*, *A. ascius*, *A. boliviensis*, *A. columbi*, *A. cubensis*, *A. cyaneus*, *A. erebus*, *A. hispaniolicus*, *A. inca*, *A. insularis*, *A. intermedius*, *A. jamaicensis*, *A. lanosus*, *A. mexicanus*, *A. mourei*, *A. ochromops*, *A. peninsularis*, *A. sapphirinus*. Forty-six names are listed as synonyms, 26 for the first time. Twenty-two species previously placed in *Agapostemon* but now placed in other genera are listed.

Separate keys are provided for species from America north of Mexico, Meso-America, The West Indies and South America. All species are described and most are illustrated. The geographic distribution and variation of the species and species groups are discussed, with particular regard to speciation of North American groups.

## INTRODUCTION

The genus *Agapostemon* occurs only in the Western Hemisphere where it ranges from southern Canada to Paraguay. It is the only member of a group of allied genera to be found north of Mexico—South America being the center of abundance of most of its relatives.

*Agapostemon* is polythetic and cannot be differentiated from related genera on the basis of any one character or group of characters. Nevertheless, most species are characterized by their metallic green or blue head and mesosoma and their contrasting black or black and yellow metasoma.

Until recently, the biology of this genus was poorly known. However, in 1969 Eickwort and Eickwort described in detail the nesting and foraging behavior of *A. nasutus* in Central America. In the same year I reported on the biology of the North American *A. radiatus*, *A. splendens* and *A. texanus* and summarized available information on other species. These biological investigations have complemented the present classification.

The primary objective of this revision is to describe and classify the species of *Agapostemon* and to elucidate their evolutionary history. It is possible to recognize species groups and in some cases provide reasonable

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explanations of their origins, but the number of species with no apparent affinities proscribes extensive speculation on the phylogeny of the genus.

A second objective of this work is to facilitate identification of species of *Agapostemon*. To this end keys, descriptions and illustrations have been prepared in as simple and uniform a style as possible. Species descriptions are in alphabetical sequence, because I believe a phenetic or "phylogenetic" sequence presumes too much knowledge on the part of the readers. The keys are regional and artificial for the sake of brevity and clarity respectively.

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### HISTORICAL REVIEW

The taxon *Agapostemon* was first proposed in 1844 by F. E. Guérin-Ménéville as a subgenus of *Andrena* in the following statements:

Nous connaissons plusieurs espèces à cuisses ainsi renflées. Ce sont des mâles. Peut-être jugera-t-on à propos de les réunir en un sous-genre, que nous proposerions de nommer *Agapostemon*. Il serait aux *Andrenes* ce qu'est le genre *Nomia* parmi les *Halictes*.

The only included species was *Andrena (Agapostemon) femoralis* Guérin 1844. Dalla Torre (1896) correctly recognized this species to be a junior synonym of *Apis viridula* Fabricius 1793. Therefore the correct name for the type species of the genus *Agapostemon* is now *Agapostemon viridulus* (Fabricius). *Agapostemon* was first described and accorded generic rank in 1853 by Frederick Smith, who listed seven species, four of them new. In 1896 Dalla Torre catalogued 16 species and placed four species in synonymy. He also gave the Latin translation of Guérin's transliterated Greek compound, *Agapostemon*, as "ἀγαπω ἀμο, στήμων *stemon*." In English the translation is "lover of stamens."

In 1897 Robertson redescribed the species known from the United States and listed their synonyms. The first key, published by Titus in 1901, included only the species known to occur in Colorado, and in November of the same year Crawford revised the North American species of *Agapostemon*. In this revision Crawford re-described the genus, described seven new species, and included a key to the 15 species then known from North America. In 1902 Robertson published keys to the genera and species of the North American Halictinae in which he commented on the relationships of the genera. Although he cited very few characters, the keys and generic concepts were remarkably good.

In 1903 Vachal reduced *Agapostemon* to subgeneric rank in *Halictus*. He included 28 species (nine of them new) in the subgenus *Agapostemon* and proposed the new subgenus *Paragapostemon* for 25 additional species

with hairy eyes and without a complete propodeal carina. Although his keys were good, Vachal's conservative generic concepts were not widely accepted, and Cockerell (1905) accorded generic rank to both *Agapostemon* and *Paragapostemon*. Vachal did not cite a type species for *Paragapostemon*, but Cockerell (1905, in footnote) designated *Halictus (Paragapostemon) podager* Vachal as the type species.

Schrottky (1909a) erected the genus *Pseudagapostemon* (type species *Agapostemon arenarius* Schrottky), thereby removing most of the species from *Paragapostemon* as well as additional species from *Agapostemon*. Schrottky published another paper (1909b) in which he reduced seven species of South American *Agapostemon* to synonymy and transferred four more from *Agapostemon* to *Pseudagapostemon*. In 1918(a) Cockerell reduced *Pseudagapostemon* to subgeneric rank in *Agapostemon*, but never referred to it as such thereafter.

In 1936 Sandhouse revised the species of *Agapostemon* occurring in the United States. Although she examined about 4,000 specimens, her work does not make sufficient allowance for intraspecific variation, none of the species are described, the only figures (of genitalia) are inadequate, and finally, she did not recognize five of the species now known from the United States; *A. femoratus*, *A. tyleri*, *A. nasutus*, *A. peninsularis* and *A. leunculus*. Despite these shortcomings, Sandhouse's revision has remained the best available reference on the genus for more than thirty years. More recent systematic treatments of *Agapostemon* are the contribution by Michener (1951) to the catalog of North American Hymenoptera; and the key, descriptions and figures for the species in the eastern United States (Mitchell, 1960).

#### EXCLUDED SPECIES

The following is a list of species which, although described in or subsequently transferred to *Agapostemon*, are no longer considered to belong to this genus. When possible the genus to which they belong has been indicated. Some of the species are synonyms but listing of synonymies must be postponed until *Paragapostemon* and *Pseudagapostemon* can be revised.

In 1918(a) Cockerell reduced *Pseudagapostemon* to a subgenus of *Agapostemon* but this classification has never won acceptance. The only species mentioned by Cockerell [*Agapostemon (Pseudagapostemon) xanthorhinus* Cockerell, *Halictus citricornis* Vachal, *Pseudagapostemon paulista* Schrottky, and *Pseudagapostemon nasua* Schrottky] have been omitted from the following list.

##### *Augochloropsis*

*Agapostemon caeruleus* Ashmead 1890 was placed in *Augochloropsis* by Titus (1901).

*Paragapostemon*

*Nomia caelestina* Westwood 1875, placed in *Agapostemon* by Cockerell (1910a), was placed in *Paragapostemon* by Moure (1964).

*Agapostemon bruneri* Crawford 1901 was placed in *Paragapostemon* by Moure (1964).

*Halictus (Agapostemon) sicheli* Vachal 1901 was placed in *Paragapostemon* by Moure (1964).

*Nomia tacita* Cameron 1902, placed in *Agapostemon* by Cockerell (1910a), was placed in *Paragapostemon* by Moure (1964).

*Nomia cillaba* Cameron 1902, placed in *Agapostemon* by Cockerell (1910a), was placed in *Paragapostemon* by Moure (1964).

*Ruizantheda*

*Halictus emarginatus* Spinola 1851, placed in *Agapostemon* by Cockerell (1905), is a synonym of the type species (*Halictus proximus* Spinola 1851) of *Ruizantheda* Moure 1964.

*Halictus mutabilis* Spinola 1851, placed in *Agapostemon* by Schrottky (1903), became the type species of *Ruizantheda (Ruizanthedella)* Moure 1964.

*Halictus placidus* Smith 1879 was placed in *Agapostemon* by Cockerell (1905), but Moure (*in litt.*) places it in *Ruizantheda*.

*Pseudagapostemon*

*Agapostemon arenarius* Schrottky 1902(b) became the type species of *Pseudagapostemon* Schrottky 1909(a).

*Agapostemon aeneus* Schrottky 1902(a) was placed in *Pseudagapostemon* by Schrottky (1909b).

*Agapostemon arechavaletae* Schrottky 1908 was placed in *Pseudagapostemon* by Schrottky (1909b).

*Agapostemon bonaërensis* Schrottky 1908 was placed in *Pseudagapostemon* by Schrottky (1909b).

*Halictus (Agapostemon) pissisi* Vachal 1903 was placed in *Pseudagapostemon* by Vachal (1904).

*Halictus (Agapostemon) divaricatus* Vachal 1903 was placed in *Pseudagapostemon* by Vachal (1904).

*Agapostemon olivaceo-splendens* Strand 1910 was placed in *Pseudagapostemon* by Moure (1947).

*Agapostemon zosteronedys* Moure 1940 belongs in *Pseudagapostemon divaricatus* (Vachal) as indicated by Moure (footnote in Michener and Lange, 1958).

Species *Incertae Sedis*

*Halictus bruchianus* Schrottky 1908 was placed in *Agapostemon* by Schrottky (1913). Moure (*in litt.*) has not seen the type but believes it should be placed in *Corynura* or *Ruizantheda* (probably the latter).



## GENERIC DIAGNOSIS

No one character or set of characters was found to be both necessary and sufficient to distinguish all species of *Agapostemon* from all species in other halictine genera. However, the genus may be recognized by a syndrome of characters. This set of characters is common to most species of *Agapostemon* but not all of its characters are present in all of the species.

The character which is unique to *Agapostemon* and which best separates this genus from other halictine genera is the carina which in most species entirely surrounds the posterior surface of the propodeum of both sexes. Also unique among halictines is the striking contrast between the non-metallic coloration of the metasoma and the metallic coloration of the head and mesosoma of most female and nearly all male *Agapostemon*.

Female *Agapostemon* may be distinguished from females of most other halictine genera by the three or four (sometimes as many as seven) large spatulate teeth on the posterior hind tibial spur and by the parallel contiguous carinae extending postero-dorsally from the antero-ventral margin of the gena. Male *Agapostemon* may be distinguished from males of the augochlorine genera and the genera in the *Halictus-Lasioglossum* group by the fusion of the first two tarsomeres of the hind tarsus. Unlike those of almost all other halictine genera, the hind femora and, to a lesser extent, the hind tibiae of many male *Agapostemon* are conspicuously swollen. The only other genera with similarly modified legs have conspicuously hairy eyes in contrast to the glabrous or nearly glabrous eyes of *Agapostemon*.

## INFRAGENERIC STRUCTURE

While it seems premature to speculate at length on the phylogeny of the species of *Agapostemon*, certain discrete groups of species can be recognized on the basis of such features as genitalia, pronotum, legs, metasomal sterna and color pattern. These species groups might have been recognized as subgenera, but to be consistent I would have been forced to recognize an unacceptable number of small or monotypic subgenera. Subspecies are not recognized because there is little biological or utilitarian justification for such in this genus. Of course, intra-specific variation is described wherever encountered.

In the following list the name of the first member (chosen arbitrarily) of each species group has not been indented and will serve to identify the group in subsequent discussion (e.g., the species in the *splendens* group are *A. splendens*, *A. texanus* and *A. angelicus*).

*kolliellus*  
*centratus*  
*poeyi*  
*insularis*  
*jamaicensis*  
*viequesensis*  
*columbi*  
*ochromops*  
*sapphirinus*  
*cyaneus*  
*aenigma*  
*viridulus*  
*obscuratus*  
*hispaniolicus*  
*cubensis*  
*alayoi*  
*swainsonae*

WEST  
INDIAN

NORTH  
AMERICAN

*splendens*  
*texanus*  
*angelicus*  
*radiatus\**  
*cockerelli*  
*femoratus\**  
*virescens\**  
*tyleri*  
*coloradinus\**  
*melliventris*  
*peninsularis*  
*mexicanus*

MESO-AMERICAN  
(except those  
with asterisk)

*rhopalocera*  
*erebus*

SOUTH  
AMERICAN  
(except *atrocaeruleus*)

*ascius*  
*leunculus*  
*nasutus*  
*atrocaeruleus*  
*semimelleus\**  
*chapidensis\**  
*intermedius*

*heterurus*  
*inca*  
*mourei*  
*boliviensis*  
*lanosus*

## ZOOGEOGRAPHY

Although more than 50,000 specimens were examined in the course of this study, I was hampered by inadequate collections from the West Indies as well as Central and South America. While it seems unlikely that any new North American species will be discovered, it is likely that new species remain to be found in the West Indies, Central America and the Andean region of South America.

It is difficult to comprehend what factors influence the distribution of species of *Agapostemon*. Only in the correlation between the distribution of *A. splendens* and that of moist sandy soils in the eastern United States and eastern Mexico is there evidence of a causal relation between the presence of an ecological parameter and the presence of the bees (Roberts, 1969).

Some species, such as *A. coloradinus*, are relatively restricted in range while others are widespread, *A. texanus* occurring from Canada to Costa Rica and Boston to San Francisco. In the United States alone, *A. texanus* occurs in 70 of 116 plant communities (Appendix A). *A. angelicus* occurs from below sea level in Death Valley, California to 12,000 ft. (3,658 m) on Mt. Evans in Colorado (timberline 11,700 ft.). In view of the apparent ecological plasticity among most species, it is not surprising that their distributions broadly overlap.

**North American Species.** There are four North American species groups. Each of these groups is composed of two very similar species and a third species which, although obviously closely related, stands somewhat apart phenetically. In each group but one, the two most similar species are found west of the 95th meridian and the third species is found north and east of the others. There is some sympatry within each species group, but the center of distribution is different for each species within a group (Fig. 228).

The simplest explanation for the occurrence of these similar geographic and cladistic patterns in each of the North American species groups is to assume: (1) North America was originally occupied by four species; (2) each species was bisected into southeastern and southwestern populations at the time of Pleistocene glaciation; and (3) the southwestern populations were more recently subdivided (possibly on the Pacific and Gulf coasts of Mexico) when forced to migrate farther south by still further cooling. Presumably this pattern of evolution is not evident among the Meso-American and West Indian species groups because they were too far south to have been significantly displaced by the climatic changes accompanying Pleistocene glaciation.

**West Indian Species.** The West Indian species are interesting in that they are not found on the mainland (with the doubtful exception of *A.*



*aenigma*) and are not closely related to the mainland species. This is somewhat surprising in view of their relative proximity to the Florida and Yucatan peninsulas. Also surprising is their absence in the lesser Antilles; yet their occurrence throughout the Bahama Islands and Greater Antilles constitutes prima-facie evidence of high vagility.

Although it is extremely improbable that the bees fly of their own accord between islands, it does seem likely that they are occasionally swept up by hurricanes and deposited on other islands many miles distant. Members of the *poeyi* and *viridulus* groups are widespread (cf. map, Fig. 1). As there is very little discernible correlation of geographic factors with the phenotype among members of each of these phenetically homogeneous species groups, I am inclined to believe that, relative to their rates of evolution, their rates of dispersal have been rapid.

In studying the *poeyi* group I vacillated between considering all of the island populations as conspecific and considering each population as a separate species. *A. poeyi* and *A. viequesensis*, occurring in Cuba and Puerto Rico respectively, have long been considered as distinct species which could easily be differentiated morphologically. However, as morphologically intermediate forms exist on the Bahama Islands, it is tempting to classify the entire group as a single highly variable species. However, phenetically typical populations of *A. poeyi* and *A. viequesensis* are sympatric on New Providence Island, and there is no evidence of hybridization. The phenetic homogeneity within each of the phenetically different populations of this complex on other islands leads me to believe that gene flow between these allopatric populations is also inconsequential. Thus it seems that in the *poeyi* group the rate of speciation, or creation of clades, is high relative to the rate of evolution, or shift in gene frequency. Although not as large and widespread, the *viridulus* group similarly appears to be speciating relatively rapidly. My decision to regard the *A. poeyi* group as an *Artenkreis* rather than a *Rassenkreis* is based on scanty evidence. However, the decision is a taxonomic necessity which in no way effects the biological attributes of the organisms in question.

The species *A. kohliellus* and *A. centratus* do not seem closely related to any other species of *Agapostemon*. Rare species, they may be restricted to a particular ecological factor found only on the island of Hispaniola. Such a severe ecological limitation could explain their absence on the other islands.

**Meso-American Species.** The distributions and relationships of the species occurring in this region are difficult to interpret. Some of the species such as *A. mexicanus* or *A. tyleri* clearly belong to North American groups although *A. mexicanus* is found in northwestern Mexico and *A. tyleri* ranges southward on the central plateau to the vicinity of Mexico City.

*A. rhopalocera* is a rare species known only from males, not obviously

related to other species and restricted to the vicinity of Mount Orizaba in Vera Cruz. *A. erebus* is known from a single female collected in El Salvador, but is obviously closely related to *A. leunculus* which ranges from the southern tip of Texas to eastern Ecuador, and also to a third species, *A. ascius*, known from two females collected in Colombia.

Males of *A. nasutus* are unlike those of any other species inasmuch as their genitalia and clypeal region are both highly modified. They also differ from males of other species in less striking features such as the lateral tufts of pubescence on the 6th metasomal sternum. Despite these obvious peculiarities of males, females of *A. nasutus* are somewhat similar to those of the *erebus* group (differing principally in the shape of the pronotum). The commonest species throughout most of its range, *A. nasutus* is found from the southern tip of Texas to northern South America, as far east as Trinidad, and west of the Andes as far south as Ica, Perú.

*A. atrocaeruleus* has been found only in Costa Rica but is closely related to a pair of species found primarily south of the Amazon Basin but reaching as far north as Ecuador. *A. intermedius* is found from Costa Rica to Tingo Maria, Perú and obviously links the *atrocaeruleus* group with the Andean *heterurus* group.

In summary, most of the Meso-American species of *Agapostemon* belong in North or South American species groups. Only the very widespread and abundant *A. nasutus* and the very restricted and rare *A. rhopalocera* have no apparent affinities with either North or South American species, or each other.

**South American Species.** Some of the species occurring in South America such as *A. nasutus*, *A. intermedius* and *A. ascius* are restricted to the northwestern margin of the continent. Apparently these species, which are recently evolved or recently arrived via Central America (e.g., *A. nasutus*), have found further access to the continent blocked by the Andes to the east, the Atacama Desert to the south, and the forests of the Orinoco Basin to the north.

*Agapostemon chapadensis* and *A. semimelleus* are the only species widely distributed in South America. Both are found in the *campos*, or subtropical grasslands, of southern Brasil, Paraguay and northern Argentina. In addition isolated populations of *A. semimelleus* have been collected from the headwaters of the Marañon, Huallaga and Cauca rivers. Presumably, these species were able to ascend the valleys at some time in the past when the South American grasslands were more extensive than today. Surprisingly, *A. semimelleus* has been collected at the head of the Cauca Valley in Colombia. I cannot explain this occurrence as the Cauca River drains into the Caribbean Sea. Specimens of *A. semimelleus* have been collected from localities as near as the headwaters of the Putumayo River, but the Cauca and Putumayo

rivers are separated by at least 200 kilometers of mountains (Cordillera Central) rising as high as 5755 m. The closest relative of *A. semimelleus* and *A. chapadensis* is *A. atrocaeruleus* which has been collected only on the central plateau of Costa Rica, nearly 1000 km from the headwaters of the Cauca River.

The most aberrant species group in *Agapostemon* includes *A. heterurus*, *A. inca*, *A. boliviensis*, *A. lanosus* and *A. mourei*. These species are very closely related and are restricted to the eastern margins of the central Andes. As many of the valleys in this region are both ecologically isolated and poorly collected, it seems reasonable to predict that more species in this group will be discovered.

*A. intermedius* is morphologically intermediate between the *A. heterurus* group and the *A. atrocaeruleus* group. *A. intermedius* ranges from central Costa Rica, where it is sympatric with *A. atrocaeruleus*, to northwestern South America. It has also been collected from Tingo Maria at the head of the Huallaga Valley where it is sympatric with *A. lanosus*. Possibly *A. intermedius* is part of an *Artenkreis* running from Costa Rica down to the grasslands of Brasil (the *A. atrocaeruleus* group) and down to the eastern margins of the Andes (the *A. heterurus* group).

## METHODS

**TERMINOLOGY.** The terminology is essentially that utilized by Michener (1944, 1965). However, the following terms have been proposed since no appropriate ones existed for these features.

The *propodeal shield* is the flat or slightly concave area on the posterior vertical surface of the propodeum usually delimited by a conspicuous *propodeal carina* (Fig. 25). Male genitalia often bear an *apical stylus*, *medial plate* and *basal stylus* on the mesal surface of the gonostylus (Fig. 180). Although often reduced and covered by long bristles, a *ventral lobe* (Fig. 223) is always present on the ventral surface of the gonocoxite.

The specific importance of the maculations of male legs has necessitated a more precise and morphologically consistent system for designating various portions of the legs than that used by Michener and others. The legs of bees, like those of most insects, may move anteriorly and posteriorly, and may be flexed ventrally and extended laterally. The middle legs, when extended, are nearly perpendicular to the longitudinal axis of the body (presumably the "primitive" condition in the Arthropoda). The fore legs and hind legs, however, are directed respectively forward and rearward to a greater or lesser degree. Owing to the rearward orientation of the hind legs of bees (especially in pinned specimens and in live bees in flight), that which is designated by previous authors as the "inner" surface of the hind legs is not homologous with what they term the "inner" surface of the fore legs.

Therefore, I propose a terminology consistent with the presumed serial homology of the parts of the three pairs of legs rather than with the positions in which they are borne. Although this system may at first seem strange and cumbersome, it is economical in that one can refer, for example, to serially homologous maculations as being on the posterior surfaces of all three pairs of legs. With the system used by other authors one could not refer to such maculations as being on the "inner" surfaces of all three pairs of legs. The disadvantage of the proposed system is that the "dorsal" quadrant of the tarsus may be visible only from below (due to the flexed position of the leg), and the "anterior" surface of the hind leg only from the side.

In the following descriptions, the legs are considered as extended at right angles to a sagittal plane through the body of the bee. The hypothetical leg segment is regarded as cylindrical, its cross-section divided by perpendicular diagonals into dorsal, ventral, anterior and posterior quadrants.

DESCRIPTION. To conserve space, the reader is often referred to the description of another species or sometimes the opposite sex. All interspecific comparisons are between members of the same sex unless otherwise specified.

Because sexual dimorphism is so pronounced in *Agapostemon*, characters used to differentiate males (or females) of two closely related species are not always present on members of the opposite sex. In some instances members of only one sex can be differentiated morphologically. In other cases the morphological differences between species are so subtle as to render identification difficult regardless of sex. For these reasons distributions have been used (especially in the keys) wherever morphological differentiation was difficult or impossible. Of course, no species is recognized solely on the basis of its distribution. The reader must be cautious in relying on distributional differentia because the ranges of species are subject to change without notice.

If two species are very similar then only one is described and the other is described as identical but for the differentiating characters. Relative size is presented as proportions and absolute size may be derived from scale drawings. For each character, the drawings are to the same scale to facilitate size comparisons between species.

Synonymies have been kept as brief as possible and no references to synonyms have been made unless they involve nomenclatural changes of specific epithets. An effort was made to locate and examine the primary types of all nominal species and subspecies and, whenever possible, their location has been noted in the synonymy. In quotations of label data on the types of new species, a single slash indicates the break between lines on a label and a double slash the break between labels on a pin.

KEY TO SPECIES OF THE UNITED STATES  
AND CANADA

1. Female; 10 flagellomeres; scopa on hind leg ..... 2  
 Male; 11 flagellomeres; scopa absent ..... 14
- 2.(1) Metasomal terga bright metallic green to blue, concolorous with head and mesosoma ..... 3  
 Metasomal terga black to pale amber, not concolorous with metallic head and mesosoma ..... 7
- 3.(2) Wings almost hyaline, only slightly darkened on distal margins; mandible yellow basally ..... 4  
 Wings transparent brown, distal margins conspicuously darkened; mandible usually amber basally (rarely yellow) ..... *splendens*
- 4.(3) Mesoscutum with numerous fine punctures interspersed with fewer distinctly larger and deeper punctures; punctuation often so fine as to leave mesoscutum shiny (Figs. 23, 24) .....  
 ..... *texanus* and *angelicus*\*  
 Mesoscutum coarsely punctate or rugose, lacking punctures of two distinct sizes and never shiny ..... 5
- 5.(4) Mesoscutum coarsely rugose at least on inner borders of parapsidal lines, if not rugose throughout ..... *femoratus*  
 Mesoscutum between parapsidal lines coarsely punctate, not rugose ..... 6
- 6.(5) Common in eastern half of U.S., becoming rare in the Great Plains (Fig. 18) ..... *radiatus*  
 Common on Mexican Plateau and in arid southwestern U.S., rare along eastern border of Rocky Mountains (Fig. 2) ..... *cockerelli*
- 7.(2) Posterior lobe of pronotum with pale yellow or creamy spot at apex (Fig. 134); clypeus with yellow transverse band (Fig. 42) .....  
 ..... *nasutus*  
 Posterior lobe of pronotum metallic at apex, never creamy or yellow; clypeus with or without yellow transverse band ..... 8
- 8.(7) Clypeus with transverse apical or subapical yellow band; metasoma black or pale amber ..... 9  
 Clypeus metallic with apical region dark brown to black; metasoma always black ..... 10
- 9.(8) Pronotum with single conspicuous sharp carina extending postero-ventrally from lateral angle (Fig. 135); metasomal terga black with narrow basal bands of white tomentum; scape dark brown to black, lacking yellow ..... *leunculus*  
 Pronotum without conspicuous sharp carina extending postero-ventrally from lateral angle (may have several small carinulae); metasomal terga pale amber to black, with white tomentum on basal halves; scape sometimes marked with yellow ..... 12
- 10.(8) Genal ridges coarse (2-3 per 0.25 mm) (Fig. 28); mandible usually yellow basally ..... *virescens*  
 Genal ridges fine (5-6 per 0.25 mm); mandible amber to brown-black basally ..... 11

\* The females of *A. texanus* and *A. angelicus* cannot be reliably separated on the basis of their morphology; however, females occurring well outside the range of *A. angelicus* males are probably *A. texanus* (see map, Fig. 20).



- 11.(10) Wings transparent brown; white tomentum lacking on anterior part of first metasomal tergum; protuberance above clypeus without large, central, shiny area ..... *coloradinus*  
 Wings hyaline, not brown; white tomentum on anterior part of first metasomal tergum ..... 13
- 12.(9) Dorsal area of propodeum moderately to coarsely rugose; scape often marked with yellow; metasomal terga amber to black or black with amber anteriorly on tergum 1 ..... *melliventris*  
 Dorsal area of propodeum finely rugose to finely rugulose; scape never with yellow markings; metasomal terga always entirely black ..... *peninsularis*
- 13.(11) Supraclypeal protuberance with smooth shiny central area with scattered punctures; found only in Arizona, New Mexico and on the Mexican Plateau (Fig. 27) ..... *tyleri*  
 Supraclypeal protuberance with weakly and transversely rugose central area; occurs around Gulf of California ..... *mexicanus\*\**
- 14.(1) Clypeus conspicuously concave ventrally, more than three times as broad as long (Figs. 86, 87) ..... *nasutus*  
 Clypeus normal, little broader than long ..... 15
- 15.(14) First metasomal tergum yellow to very pale amber basally, not brown or black, and hind basitarsus always slender and simple (Fig. 155); hind leg yellow with small brown or black area apically on femur and basally on tibia ..... *melliventris*  
 First metasomal tergum brown to black basally (if pale amber, then hind basitarsus swollen and with basal ridge and apical groove); hind leg usually with dark brown to black stripe on tibia ..... 16
- 16.(15) Hind femur without tooth; slender ..... 25  
 Hind femur with subapical tooth postero-ventrally; often conspicuously inflated ..... 17
- 17.(16) Wings transparent brown, conspicuously darkened at distal margins; hind basitarsus with crest of basal ridge grooved (Fig. 166) ..... *splendens*  
 Wings hyaline or nearly so, not conspicuously darkened at distal margins; hind basitarsus with basal ridge (if present) not grooved ..... 18
- 18.(17) Metasoma with last two visible sterna (5-6) dark brown to brown-black, without yellow maculations; sterna 2-4 with yellow (if present) restricted to basal margins ..... 19  
 Metasoma with extensive yellow maculations on last two visible sterna (5-6) as well as on sterna 2-4 ..... 21
- 19.(18) Hind femur lacking brown to black stripe on posterior surface (Fig. 158) ..... *virescens*  
 Hind femur with large brown to black stripe covering most or all of posterior surface ..... 20
- 20.(19) Brown to black streak less than  $\frac{2}{3}$  length of posterior surface of hind tibia (Fig. 160) ..... *coloradinus*  
 Brown to black streak extending entire length of posterior surface of hind tibia (Fig. 159) ..... *tyleri*

\*\* Although not currently known to occur in the United States, this species may yet be found in the vicinity of San Diego or Yuma, thus it is included in this key.

21.(18)	Metasomal sternum 4 (antepenultimate visible) with low transverse ridge not quite reaching posterior margin laterally; metasomal tergum 4 usually without conspicuous metallic tints .....	22
	Metasomal sternum 4 (antepenultimate visible) with low transverse ridge reaching posterior margin laterally; metasomal tergum 4 nearly always with conspicuous metallic tints .....	24
22.(21)	Hind basitarsus lacking apical groove and basal ridge (Fig. 161) .....	<i>radiatus</i>
	Hind basitarsus with apical groove and basal ridge .....	23
23.(22)	Hind basitarsus with inconspicuous basal ridge and slender apical groove (Fig. 162) .....	<i>cockerelli</i>
	Hind basitarsus with very large, conspicuous, slightly sinuate basal ridge and broad, conspicuous apical groove (Fig. 163) ...	<i>femoratus</i>
24.(21)	Base of apical stylus of gonostylus slightly inflated (Fig. 181); brown to black stripe on posterior surface of hind tibia but never on anterior surface (Fig. 164) .....	<i>angelicus</i>
	Base of apical stylus of gonostylus not inflated (Fig. 180); brown to black stripe anteriorly on hind tibia (Fig. 165), or, if lacking, then without black stripe on posterior surface .....	<i>texanus</i>
25.(16)	Posterior surface of hind tibia largely yellow (Fig. 143) .....	<i>leunculus</i>
	Posterior surface of hind tibia largely brown or black .....	26
26.(25)	2-4 large submarginal bristles on each side of metasomal sternum 4 .....	<i>peninsularis</i>
	14-20 large, evenly spaced submarginal bristles on metasomal sternum 4 .....	<i>mexicanus*</i>

KEY TO MESO-AMERICAN\*\* SPECIES

1.	Males; 11 flagellomeres; scopa absent .....	2
	Females; 10 flagellomeres; scopa on hind legs .....	15
2.(1)	Antenna normal .....	3
	Antenna long, filamentous, and with apical flagellomere flattened (Fig. 131) .....	<i>rhopalocera</i>
3.(2)	Clypeus normal, little longer than broad .....	4
	Clypeus conspicuously concave ventrally, more than three times as broad as long (Figs. 86, 87) .....	<i>nasutus</i>
4.(3)	Metasoma banded with yellow and dark brown or black, lacking bands of white tomentum .....	5
	Metasoma pale amber, with bands of white tomentum .....	<i>centratus</i>
5.(4)	Sixth metasomal sternum flat or with inconspicuous medial ridge .....	6
	Sixth metasomal sternum with medial "button" (flattened process resembling human tongue and attached to sternum in much the same way as human tongue is attached to floor of mouth (Fig. 136) .....	<i>intermedius</i>
6.(5)	Hind femur with conspicuous subapical tooth postero-ventrally .....	7
	Hind femur lacking tooth .....	11

\* Although not currently known to occur in the United States, this species may yet be found in the vicinity of San Diego or Yuma, thus it is included in this key.

\*\* Mexico, Panama, and intervening countries.

7.(6)	Wings hyaline or nearly so, not conspicuously darkened at distal margins; hind basitarsus with basal ridge (if present) not grooved .....	8
	Wings transparent brown, conspicuously darkened at distal margins; hind basitarsus with crest of basal ridge grooved (Fig. 166) .....	<i>splendens</i>
8.(7)	Metasoma with extensive yellow maculations on sterna; hind tibia with brown or black posterior stripe (when present) not extending from base to apex .....	9
	Metasoma with sterna brown or black, lacking yellow maculations; hind tibia with broad brown or black posterior stripe extending from base to apex .....	<i>tyleri</i>
9.(8)	Metasomal sternum 4 (antepenultimate visible) with low transverse ridge reaching posterior margin laterally; metasomal tergum 4 nearly always with conspicuous metallic tints .....	10
	Metasomal sternum 4 (antepenultimate visible) with low transverse ridge not quite reaching posterior margin laterally; metasomal tergum 4 without conspicuous metallic tints .....	<i>cockerelli</i>
10.(9)	Base of apical stylus of gonostylus slightly inflated (Fig. 181); brown to black stripe on posterior surface of hind tibia but never on anterior surface (Fig. 164) .....	<i>angelicus</i>
	Base of apical stylus of gonostylus not inflated (Fig. 180); brown to black stripe anteriorly on hind tibia (Fig. 165) or, if lacking, then without black stripe on posterior surface .....	<i>texanus</i>
11.(6)	Base of metasomal tergum 1 dark brown or black .....	12
	Base of metasomal tergum 1 yellow or pale amber .....	<i>melliventris</i>
12.(11)	Hind leg with broad brown or black stripe covering most of posterior surface of tibia and extending from base to apex; similar stripe on femur sometimes broken centrally .....	13
	Hind leg largely yellow on posterior surface of tibia and femur .....	14
13.(12)	Metasomal sternum 4 with 2-4 large submarginal bristles on each side .....	<i>peninsularis</i>
	Metasomal sternum 4 with 14-16 large, evenly spaced submarginal bristles .....	<i>mexicanus</i>
14.(12)	Pronotum with very acute lateral angle; mesoscutum with conspicuous flange laterally on anterior margin .....	<i>atrocaeruleus</i>
	Pronotum with lateral angle rounded; mesoscutum lacking flange on anterior margin .....	<i>leunculus</i>
15.(1)	Metasomal terga bright metallic green to blue-green .....	16
	Metasomal terga pale amber to black, not metallic .....	19
16.(15)	Mandibles amber with metallic green spot basally; dorsal area of pronotum with very large, widely separated carinae extending from anterior margin to propodeal carina .....	<i>aenigma*</i>
	Mandibles amber or yellow, lacking metallic spot basally; pronotum rugose dorsally .....	17
17.(16)	Wings almost hyaline, only slightly darkened on distal margins; mandibles yellow basally .....	18
	Wings transparent brown, distal margins conspicuously darkened; mandibles usually amber (sometimes yellow) basally ....	<i>splendens</i>

\* Although labeled "Costa Rica" the two specimens of *A. aenigma* are closely related to West Indian species and may be mislabeled.



- 18.(17) Mesoscutum coarsely punctate to finely rugose, lacking punctures of two distinct sizes and never shiny ..... *cockerelli*  
 Mesoscutum with numerous fine punctures interspersed with fewer distinctly larger and deeper punctures, punctation often so fine as to leave mesoscutum shiny (Figs. 23, 24) .....  
 ..... *texanus* and *angelicus*\*\*
- 19.(15) Lateral angle of pronotum acutely pointed; mesoscutum with conspicuous flange laterally on anterior margin ..... 20  
 Lateral angle rounded, not acutely pointed; mesoscutum lacking conspicuous flange on anterior margin ..... 21
- 20.(19) Head and mesosoma black (usually with inconspicuous dark blue tints and with yellow band on clypeus); metasoma black with bands of white tomentum ..... *atrocaeruleus*  
 Head and mesosoma metallic green or coppery; metasoma pale amber to black, with yellow integumental bands replacing usual bands of white tomentum ..... *intermedius*
- 21.(19) Posterior lobe of pronotum metallic at apex, never creamy or yellow; clypeus with or without yellow transverse band ..... 22  
 Posterior lobe of pronotum with creamy or yellow spot at apex; clypeus with yellow transverse band ..... *nasutus*
- 22.(21) Clypeus with transverse, subapical, yellow band; metasoma amber to black ..... 23  
 Clypeus black at apical margin, lacking yellow band; metasoma always black ..... 25
- 23.(22) Pronotum without single conspicuous sharp carina extending postero-ventrally from lateral angle (may have several small carinulae); metasomal terga pale amber to black, with white tomentum on basal halves; scape dark brown to black, sometimes marked with yellow ..... 24  
 Pronotum with single conspicuous sharp carina extending postero-ventrally from lateral angle; metasomal terga with narrow basal bands of white tomentum; scape dark brown to black, lacking yellow ..... *leunculus*
- 24.(23) Dorsal area of propodeum moderately to coarsely rugose; scape often marked with yellow; metasomal terga amber to black, or black with amber anteriorly on tergum I ..... *melliventris*  
 Dorsal area of propodeum finely rugose to finely rugulose; scape never with yellow markings; metasomal terga always entirely black ..... *peninsularis*
- 25.(22) Head and mesosoma bright metallic green ..... 26  
 Head and mesosoma black with metallic purple tints ..... *erebus*
- 26.(25) Supraclypeal protuberance with smooth shiny central area and with scattered punctures; occurs in New Mexico, Arizona, and on the Mexican Plateau (Fig. 27) ..... *tyleri*  
 Supraclypeal protuberance with weakly and transversely rugose central area; occurs around the Gulf of California ..... *mexicanus*

\*\* The females of *A. texanus* and *A. angelicus* cannot be separated reliably on the basis of their morphology; however, females occurring well outside the range of *A. angelicus* males are probably *A. texanus* (see map, Fig. 20).

## KEY TO WEST INDIAN SPECIES

- |         |  |                      |
|---------|--|----------------------|
| 1.      | Males; 11 flagellomeres; scopa absent .....  | 2                    |
|         | Females; 10 flagellomeres; scopa on hind leg .....   | 16                   |
| 2.(1)   | Hind femur without tooth .....   | 3                    |
|         | Hind femur with tooth on postero-ventral margin .....  | 4                    |
| 3.(2)   | Lower portion of clypeus abruptly flattened, glabrous and impunctate (Figs. 109-110); metasomal terga yellow with black bands; from Hispaniola, Cuba and Jamaica .....                 | <i>kohliellus</i>    |
|         | Lower portion of clypeus normal, not abruptly flattened, glabrous (Figs. 121-122) or impunctate; metasomal terga honey-colored; from Haiti .....                                       | <i>centratus</i>     |
| 4.(2)   | Metasomal terga black or pale amber, never with metallic tints; clypeal region elongate .....  | 5                    |
|         | Metasomal terga with yellow and brown to black bands, often with metallic tints; clypeal region normal .....   | 9                    |
| 5.(4)   | Head and mesosoma bright metallic green to blue .....  | 6                    |
|         | Head and mesosoma shiny brown-black, not metallic; from Cuba .....   | <i>obscuratus</i>    |
| 6.(5)   | Metasomal terga dark brown to black, pale bands of tomentum conspicuous .....  | 7                    |
|         | Metasomal terga pale amber with brown bands, pale bands of tomentum inconspicuous or absent .....  | 8                    |
| 7.(6)   | Sculpturing of mesosoma slightly finer than that of <i>viridulus</i> , contiguous punctures giving the mesoscutum a dark blue appearance when viewed from above; from Hispaniola ..... | <i>hispaniolicus</i> |
|         | Sculpturing of mesosoma slightly coarser than that of <i>hispaniolicus</i> , subcontiguous punctures giving the mesoscutum slightly shiny green to blue reflections; from Cuba .....   | <i>viridulus</i>     |
| 8.(6)   | Basal ridge of hind basitarsus very broadly and deeply grooved (Fig. 147); mesoscutellum extremely shiny, only weakly sculptured; from Jamaica .....                                   | <i>swainsonae</i>    |
|         | Basal ridge of basitarsus very narrow and without broad, deep groove (Fig. 149); mesoscutellum weakly shiny with contiguous punctures; from Cuba .....                                 | <i>cubensis</i>      |
| 9.(4)   | Eye normal brown; pterostigma translucent amber to dark brown .....  | 10                   |
|         | Eye and (or) underside of pterostigma (except for dark margins) pale cream colored to opaque yellow .....  | 14                   |
| 10.(9)  | Metasomal tergum 3 weakly to strongly metallic green to blue medially .....  | 11                   |
|         | Metasomal tergum 3 without metallic green to blue medially .....   | 13                   |
| 11.(10) | Metasomal tergum 1 with metallic green to blue tints postero-laterally .....   | 12                   |
|         | Metasomal tergum 1 without metallic green to blue tints postero-laterally; from Hispaniola .....   | <i>insularis</i>     |
| 12.(11) | Hind femur 60% as wide as long (Fig. 146); from Jamaica ..   | <i>jamaicensis</i>   |
|         | Hind femur less than 55% as wide as long (Fig. 144); from Cuba, Hispaniola, New Providence I. and probably from Andros I. and Cat I. ....  | <i>poeyi</i>         |

13.(10)	Metasomal terga 4 and 5 with conspicuous metallic green tints medially; from San Salvador I. (=Watling I.) .....	<i>columbi</i>
	Metasomal terga 4 and 5 without conspicuous metallic green tints medially (may have faint metallic tints laterally); from Puerto Rico (including Mona I. and Vieques I.) and New Providence I. ....	<i>viequesensis</i>
14.(9)	Pedicle, unlike scape or flagellum, pale amber to yellow below .....	15
	Pedicle, unlike scape or flagellum, dark brown below; from Crooked I. ....	<i>cyaneus</i>
15.(14)	From Long I. ....	<i>sapphirinus</i>
	From Cat I., Rum Cay, Conception I., New Providence I. and Mariguana (=Mayaguana?) I. ....	<i>ochromops</i>
16.(1)	Metasomal terga black to pale amber, not metallic .....	17
	Metasomal terga largely metallic green to blue to purple .....	22
17.(16)	Lower portion of clypeus brown or black, metasomal terga pale amber to black, lacking yellow bands .....	18
	Lower portion of clypeus with broad yellow band; metasomal terga with yellow bands; from Hispaniola, Cuba and Jamaica ..	<i>kohliellus</i>
18.(17)	Metasomal terga uniformly brown-black with narrow, white bands of tomentum .....	19
	Metasomal terga 1 and 2 honey-colored becoming brown-black on posterior terga; from Hispaniola .....	<i>alayi</i>
19.(18)	Head and mesosoma metallic green to blue .....	20
	Head and mesosoma shiny brown-black, not metallic; from Cuba .....	<i>obscuratus</i>
20.(19)	More than 50% of interocular area above antennal sockets and below median ocellus rugose to rugulose .....	21
	More than 50% of interocular area above antennal sockets and below median ocellus with fine, deep, contiguous punctures; from Hispaniola .....	<i>hispaniolicus</i>
21.(20)	Mandible with metallic green tints basally, about as dark ferruginous-brown basally as apically; from Cuba .....	<i>viridulus</i>
	Mandible without metallic green tints basally, much darker apically than basally; from Jamaica .....	<i>swainsonae</i>
22.(16)	Metallic coloration dark blue or dark purple .....	23
	Metallic coloration green .....	24
23.(22)	Gena with fewer than 10 extremely coarse carinae; tegula and legs with some pale amber areas; from Long I. ....	<i>sapphirinus</i>
	Gena with many more than 10 fine carinae; tegula and legs dark brown; from Crooked I. ....	<i>cyaneus</i>
24.(22)	Eye normal brown; pterostigma translucent amber to dark brown .....	25
	Eye or underside of pterostigma (usually both) pale cream-colored to opaque yellow; from Cat I., Rum Cay, Conception I., New Providence I. and Mariguana (=Mayaguana?) I. ....	<i>ochromops</i>
25.(24)	Mandible with metallic green spot basally .....	26
	Mandible lacking metallic green spot basally; from Puerto Rico (including Mona I. and Vieques I.) and New Providence I. ..	<i>viequesensis</i>
26.(25)	Metasomal sterna 3 and 4 with conspicuous medial metallic green tints .....	27
	Metasomal sterna 3 and 4 brown, without medial metallic green tints .....	28

- 27.(26) Mesoscutum rugose laterally along parapsidal line, becoming coarsely rugose anteriorly, punctate centrally and posteriorly; from Cuba, Hispaniola, New Providence I., Cat I. and Andros I. .... *poeyi*  
 Mesoscutum finely punctate, with extreme antero-lateral margin rugulose; from Hispaniola ..... *insularis*
- 28.(26) Scopal hairs on femur and hairs on postero-ventral surface of hind tibia golden; from San Salvador I. (=Watling I.) ..... *columbi*  
 Scopal hairs on femur and hairs on postero-ventral surface of tibia white; from Costa Rica ..... *aenigma*\*

## KEY TO SOUTH AMERICAN SPECIES

1. Female; 10 flagellomeres; scopa on hind leg ..... 2  
 Male; 11 flagellomeres; scopa absent ..... 10
- 2.(1) Mesoscutum rounded on anterior margin; lateral angle of pronotum inconspicuous and not projecting antero-laterally ..... 3  
 Mesoscutum with acute upturned flange on anterior margin; lateral angle of pronotum conspicuous and projecting antero-laterally ..... 5
- 3.(2) Pronotum with creamy or yellow spot at apex of posterior lobe and without carina extending postero-ventrally from lateral angle (Fig. 134) ..... *nasutus*  
 Pronotum without creamy or yellow spot at apex of posterior lobe and with conspicuous sharp carina extending postero-ventrally from lateral angle (Fig. 135) ..... 4
- 4.(3) Metasoma black; lateral angle of pronotum rounded; 3 spatulate teeth on posterior hind tibial spur ..... *leunculus*  
 Metasoma amber; lateral angle of pronotum angular; 5 (rarely 4?) spatulate teeth on posterior hind tibial spur ..... *ascius*
- 5.(2) Metasomal terga 2 and 3 amber or black with yellow basally (best seen in posterior view) ..... 6  
 Metasomal terga 2 and 3 amber or black but lacking yellow ..... *semimelleus* or *chapidensis*\*
- 6.(5) Head and mesosoma dull coppery, metallic greenish-black or bluish-black; mesoscutal pubescence dense and woolly; restricted to western South America ..... 7  
 Head and mesosoma usually bright metallic green (may be coppery in Central America); mesoscutal pubescence not especially dense and finely branched; Central and South America ..... *intermedius*
- 7.(6) Propodeum metallic blue-black or green-black dorsally; clypeus without yellow maculations ..... *heterurus*  
 Propodeum metallic coppery dorsally; clypeus usually with yellow maculations ..... 8

\* *Agapostemon aenigma* is included in this key because its similarity to West Indian species casts doubt on the correctness of its "Costa Rica" label. A specimen with identical label data belongs to the Haitian species *A. centratus*.

\*The females of these species cannot be distinguished reliably (cf. *A. semimelleus*, VARIATION).

- 8.(7) Propodeum with coarse parallel striae dorso-laterally; clypeus without yellow maculations ..... *lanosus*  
 Propodeum coarsely rugose dorso-laterally; clypeus with yellow maculations ..... 9
- 9.(8) Posterior half of each metasomal tergum pale amber, prepygidial fimbria brown to black ..... *mourei*  
 Posterior half of metasomal tergum 1 and 2 dark amber, tergum 3 brown, terga 4 and 5 and prepygidial fimbria brown-black .. *boliviensis*
- 10.(1) Last visible (6th) metasomal sternum with medial, button-like protrusion basally (Figs. 136-140) ..... 14  
 Last visible (6th) metasomal sternum without button-like protrusion ..... 11
- 11.(10) Clypeus normal, little longer than broad ..... 12  
 Clypeus conspicuously concave ventrally, more than three times as broad as long (Figs. 85-87) ..... *nasutus*
- 12.(11) Lateral angle of pronotum prominent, acute and projecting antero-laterally; first metasomal tergum dull, with large, deep, subcontiguous punctures ..... 13  
 Lateral angle of pronotum rounded; first metasomal tergum shiny, with small, shallow, scattered punctures ..... *leunculus*
- 13.(12) Hind femur with brown on posterior extending from base to apex (Fig. 172); gonostylus with distal stylus about twice as long as width of medial plate (Fig. 173) ..... *chapadensis*  
 Hind femur with brown on posterior limited to base and apex (Fig. 171); gonostylus with distal stylus little longer than width of medial plate (Fig. 174) ..... *semimelleus*
- 14.(10) Hind femur less than twice as long as broad; hind basitarsus extensively marked with brown or black; basal ridge and apical groove on hind basitarsus large and conspicuous (Figs. 167-170) ..... 15  
 Hind femur more than twice as long as broad; hind basitarsus yellow, only rarely marked with brown; basal ridge and apical groove on hind basitarsus reduced and inconspicuous (Fig. 151) ..... *intermedius*
- 15.(14) Antepenultimate visible sternite (4th) without conspicuously long, contiguous, hooked setae laterally on posterior margin ..... 16  
 Antepenultimate visible sternite (4th) with two or three contiguous, long (about twice length of adjacent setae), thickened, hooked setae laterally on posterior margin ..... *lanosus*
- 16.(15) Last visible sternite (6th) with "button" about  $\frac{1}{4}$  as wide as sternite (Figs. 137, 139); basitarsus relatively broad (Figs. 167, 170) ..... 17  
 Last visible sternite (6th) with "button" about  $\frac{1}{2}$  as wide as sternite (Fig. 140); basitarsus relatively slender (Fig. 168) ..... *inca*
- 17.(16) Tegula pale amber with yellow lunule anteriorly; medial plate of gonostylus large (Fig. 176) ..... *mourei*  
 Tegula dark ferruginous, without yellow lunule anteriorly; medial plate of gonostylus small and rounded (Fig. 177A) ..... *boliviensis*



## DESCRIPTIONS, SYNONYMIES AND DISTRIBUTIONS

*Agapostemon aenigma* n. sp.

The name of this species refers to its mysterious affinity with certain West Indian species.

*Agapostemon aenigma* is known from two female specimens labeled "Costa Rica" in the same handwriting and type of label as two males of the Haitian *A. centratus*. This species appears closely related to some West Indian species and may be mis-labeled as are the similarly labeled specimens of *A. centratus*. The holotype and paratype are in the Academy of Natural Sciences, Philadelphia.

DIAGNOSIS. The female may be distinguished from other green Central American *Agapostemon* by the coarse parallel carinae on the dorsal surface of its propodeum. Among West Indian females with bright metallic green to blue metasomas, *A. aenigma* may be distinguished from females of *A. ochromops* by its lack of milky to yellowish eyes and pterostigma; from females of *A. viequesensis* by the basal metallic spot on its mandible; from females of *A. columbi* by the white (not golden) pubescence on the underside of its hind femur and tibia; and from *A. poeyi* and *A. insularis* by its lack of strong metallic tints medially on sterna 3 and 4. This species is very close to *A. insularis* and the two may eventually prove to be conspecific.

## DESCRIPTION

## FEMALE

General coloration of head, mesosoma and metasoma bright metallic greenish blue. **Head:** pubescence as in *A. viequesensis*. (1) *Labrum* as in *A. hispaniolicus*. (2-4) *Clypeus*, *interocular area* and *vertex* as in *A. viequesensis*. (5) *Gena* much more coarsely carinate than in *A. viequesensis* but not quite as coarse as in *A. poeyi*. (6) *Malar area* absent. (7-8) *Mandible* and *antenna* as in *A. poeyi*. **Mesosoma:** pubescence as in *A. viequesensis* but slightly more fuliginous on mesonotum and metanotum. (9) *Pronotum* as in *A. viequesensis* but with lateral angle and posterior lobe more angular, and with fewer and coarser (not as coarse as in *A. poeyi*) horizontal carinae postero-laterally. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. viequesensis*. (13-14) *Mesepisternum* and *metepisternum* as in *A. viequesensis* but with sculpturing very slightly coarser. (15) *Propodeum* as in *A. poeyi* but with finer sculpturing (not quite as fine as in *A. viequesensis*). (16-17) *Wing* and *tegula* as in *A. viequesensis* but with tegula darker with metallic tints more extensive. (18-20) *Fore*, *middle* and *hind legs* dark brown, coxae with strong metallic tints. Pubescence dark amber to brown, scopal hairs white. **Metasoma:** as in *A. viequesensis* but with faint metallic tints laterally on sterna 3 and 4 of paratype (cf. *A. insularis* ♀).

*Agapostemon alayoi* n. sp.

This species is named after Dr. Pastor Alayo D. of La Habana, Cuba, who has contributed significantly to our knowledge of Antillean bees.

I have seen a single specimen labeled "Acc. 1007-25/Port au Prince, Haiti., 1925//G. N. Wolcott/Coll." The type is in the United States National Museum, Washington, D.C.

**DIAGNOSIS.** The female may be distinguished from females of *A. kohliellus* by the lack of yellow on its clypeus. No other West Indian species has females with metasomal terga 1-2 pale amber. This species is phenetically closest to *A. viridulus* and *A. hispaniolicus*. It differs from both in the coloration of its metasoma, in having a more densely punctate mesoscutellum and in being larger than females of *A. hispaniolicus*.

## DESCRIPTION

## FEMALE

General coloration of head and mesosoma metallic greenish blue, metasoma honey-colored anteriorly, brown-black posteriorly. **Head:** as in *A. viridulus* but metallic blue, with very dark fuliginous hair on interocular area and vertex. **Mesosoma:** as in *A. viridulus* but metallic blue, with slightly finer, deeper and more numerous punctures on mesoscutum and mesoscutellum. Mesoscutellum not shiny as in *A. viridulus*. Sculpturing of mesepisternum, metepisternum and propodeum slightly deeper than in *A. viridulus*. Pubescence of mesoscutum, mesoscutellum and metanotum much darker fuliginous than as in *A. viridulus*. **Metasoma:** as in *A. viridulus* but terga 1-2 pale amber instead of brown-black.

*Agapostemon angelicus* Cockerell

*Agapostemon angelicus* Cockerell 1924. Type ♀, California Academy of Sciences.

I have seen the type in San Francisco and it is from Pond Island Bay, Angel de la Guarda Island in the Gulf of California, Mexico. As the males of *A. texanus* are rare relative to those of *A. angelicus* in this region, it seems reasonable and expedient to consider this type to be conspecific with those males which differ in genitalia and color pattern from those of *A. texanus*.

**DISTRIBUTION.** All males of *A. angelicus* have been found well within the range of the males of *A. texanus*. Owing to this sympatry and my inability to distinguish between females of *A. texanus* and *A. angelicus*, I have here considered the distribution of males and disregarded females.

Although common only in the arid regions of the southwestern United States and northern Mexico, males of *A. angelicus* have been found as far north as west-central North Dakota, as far south as northern Durango (Mexico), as far east as central Iowa, and as far west as southwestern

California. This species ranges from below sea level in Death Valley, California, to 12,000 ft. (3,658 m) on Mount Evans (timberline is at 11,700 ft.) in Colorado. The altitudinal range of *A. angelicus* is as astounding as the latitudinal range of *A. texanus*. In Arizona males of *A. angelicus* have been collected from April through November; in Kansas from June through October; and in Mexico from June through October. (Map, Fig. 20.)

Albeit uncommon, *A. angelicus* does occur in the Great Plains, where it is found together with *A. texanus* in the gallery forests of the tributaries of the Missouri and Mississippi Rivers. This habitat is the "Northern Floodplain Forest" of *Populus*, *Salix*, and *Ulmus* (no. 98 in Appendix A). While not as diverse as those of *A. texanus*, its habitats are numerous (39 of the 116 given by A. W. Küchler 1964—cf. Appendix A).

DIAGNOSIS. The male may be distinguished from many other species by its toothed hind femora, the apical stylus on its gonostylus, and the lack of a low medial ridge on the apical half of its last visible sternum; and from *A. texanus* by the shorter apical stylus with swollen base and enlarged apex on its gonostylus, and by the presence of a posterior stripe and absence of an anterior stripe on its hind tibia. The female may be distinguished from most other species by its bright metallic green to blue metasomal terga, its almost hyaline wings, and by the presence of two distinct sizes of mesoscutal punctures.

I have labeled females of *A. angelicus* as "*Agapostemon texanus* or *A. angelicus*" because I am unable to separate them from *A. texanus*. Sandhouse (1936) claimed that these species differ in the punctuation of the mesoscutum and in the color of the pubescence. After having examined many thousands of females of these species I am forced to conclude that the variation within *A. texanus* nearly encompasses the range of variation within *A. angelicus*, thus invalidating the characters used by Sandhouse. It is probably true that the modes of *A. angelicus* characters differ from those of *A. texanus* but this cannot be demonstrated without positively identified females of both species. If one were able to positively identify *A. angelicus* females, perhaps by means of rearing, it might be possible to utilize a discriminant function to distinguish between females of the two species. Owing to the occurrence of *A. texanus* males within the range of *A. angelicus* males, I was unable to obtain females which were indisputably *A. angelicus*. Even if one were to find an area where only *A. angelicus* occurred, one could not be sure that differences between these females and females of *A. texanus* were not simply geographic variations.

VARIATION. Basing the probable identity of females on the relative abundance of males, it would seem that most females of *A. angelicus* have a slightly shinier mesoscutum and whiter pubescence than most of those of *A. texanus*. Like the males, the females of *A. angelicus* probably average



slightly smaller than those of *A. texanus*, but the variation within each species is far greater than any difference between them. In both males and females of *A. angelicus* the metallic coloration is the same green as that of the sympatric *A. texanus*. The most noticeably variable character of *A. angelicus* is the amount of melanic pigmentation on the fore coxae of males, which range in color from yellow to brown-black, but intra-locality variation is far greater than inter-locality variation.

#### DESCRIPTION

##### MALE (Figs. 73-74, 164, 181)

Males as in *A. texanus* but only about 85% as large with whiter pubescence on the mesonotum and metanotum; with dark stripe present posteriorly and absent anteriorly on its hind tibia (Fig. 164); with apical stylus on its gonostylus shorter, swollen basally, and larger apically; with medial plate on its gonostylus smaller; and with basal stylus on its gonostylus broader and blunt apically (Fig. 181).

##### FEMALE (Figs. 67-68)

As in *A. texanus* but always green and probably smaller with shinier mesoscutum and whiter pubescence.

#### *Agapostemon ascius* n. sp.

The name of this species comes from the Greek *skias*, or shadow. As used in Pliny, *ascius* literally means without shadow and refers to inhabitants of those regions (i.e., the tropics) where the sun is directly overhead once or twice each year.

*Agapostemon ascius* is known from two females labeled, "5 mi. W. Cajamarca/ Tol., COLOMBIA/ II-20-1965// Figleaf/ gourd// A. E. & M. M./ Michelbacher/ Collectors// 210.1/ 0855-/ 0905." The holotype and paratype are at the University of California, Berkeley.

DIAGNOSIS. *A. ascius* may be distinguished from most other South American species by its lack of an acute upturned flange on the anterior margin of its mesoscutum, from *A. nasutus* by the lack of yellow on its posterior pronotal lobe, and from the closely related *A. leunculus* and *A. erebus* by its amber metasoma and 5 (rarely 4?) spatulate teeth on its posterior hind tibial spur.

#### DESCRIPTION

##### FEMALE

General coloration of head and mesosoma bright metallic green, metasoma amber with black at base. **Head:** (1-4) *Labrum*, *clypeus*, *interocular area* and *vertex* as in *A. nasutus*. (5) *Gena* with coarse, parallel and

anastomosing carinae. (6) *Malar area* dark amber to brown, very short. (7) *Mandible* yellowish amber basally, becoming ferruginous on apical  $\frac{2}{3}$ . (8) *Antenna* black above, dark brown below, undersides of first two flagellomeres darker than others. **Mesosoma:** metallic green, never with yellow spot on posterior lobe of pronotum as in *A. nasutus*. (9) *Pronotum* with prominent carina running postero-laterally from lateral angle; lateral angle projecting slightly but not markedly as in *A. intermedius*. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. nasutus* but punctures slightly coarser and pubescence slightly more dense. (13) *Mesepisternum* very coarsely rugose anteriorly to moderately rugose posteriorly; pubescence creamy. (14) *Metepisternum* as in *A. leunculus*. (15) *Propodeum* as in *A. nasutus* but more coarsely sculptured. (16) *Wing* as in *A. nasutus*. (17) *Tegula* dark brown with transparent spot postero-laterally. (18-20) *Fore, middle and hind legs* as in *A. leunculus*. **Metasoma:** (21) *Terga* amber with anterior half of tergum 1, posterior half of tergum 5 and lateral margins of 2-4 dark brown to black; pubescence short, sparse and inconspicuous. (22) *Sterna* brown to brown-black with long pale hairs on exposed areas.

### *Agapostemon atrocaeruleus* Friese

*Agapostemon atrocaeruleus* Friese 1916.

I am unable to locate the type of this species but have seen males and females labeled "Typus" (which only means they were identified by Friese) and they agree with his descriptions.

**DISTRIBUTION.** I have seen specimens from the following localities in Costa Rica: Cartago (2 ♂), San José (9 ♂, 7 ♀), San Mateo (1 ♂), Santiago de Puriscal (12 ♂, 7 ♀), and Turrialba (7 ♂, 12 ♀). Males have been collected from July through November and females from July through September. Members of this species have been collected from 1,950 ft. (594 m) in Turrialba up to 3,963 ft. (1,200 m) in San José.

**DIAGNOSIS.** The male may be distinguished from males of all Central American *Agapostemon* except *A. intermedius* by the very acute lateral angle and posterior lobe on its pronotum and the conspicuous flange laterally on the anterior margin of its mesoscutum; and from males of *A. intermedius* by the lack of a medial tongue-shaped process, or "button," at the base of its 6th metasomal sternum (small bump may be present, but not a distinct "button"). The female may be distinguished from females of all other species of *Agapostemon* by the combination of acutely pointed lateral pronotal angle and its almost wholly black color (usually with yellow band on clypeus and dark metallic blue tints on head and mesosoma).

## DESCRIPTION

MALE (Figs. 79-80, 142, 196, 213)

General coloration of head and mesosoma bright metallic green, metasoma banded with black and yellow. **Head** (Figs. 79-80): pubescence golden to amber, becoming creamy on gena. (1) *Labrum* as in *A. texanus* but with apical portion shorter and much more acute at apex. (2) *Clypeus* with large scattered punctures on lower (yellow) half, becoming very weakly punctate and with weak horizontal carinulae on upper (green) half. (3) *Interocular area* with moderately small and deep contiguous punctures below ocelli, becoming shallower and larger (almost rugulose) at level of antennal sockets; supraclypeal protuberance with large punctures separated by about their own diameters and inclined medially. (4) *Vertex* with moderately small, deep, contiguous punctures anteriorly becoming shallower laterally, very weakly rugose between ocelli, and becoming transversely carinate posteriorly. (5) *Gena* with parallel subcontiguous weak carinae extending dorso-laterally from antero-ventral margin. (6) *Malar area* yellow, very short. (7) *Mandible* yellow with apical  $\frac{1}{3}$  ferruginous to amber. (8) *Antenna* brown to brown-black above; scape yellow below, pedicel and flagellum yellowish to amber below. **Mesosoma**: pubescence creamy, becoming golden to amber on mesonotum and metanotum. (9) *Pronotum* with small, inconspicuous, yellow spot on posterior lobe; lateral angle and posterior lobe acutely pointed, lateral angle projecting antero-laterally, sharp carina extending postero-ventrally from apex of lateral angle, and weak horizontal carinulae postero-ventrally. (10) *Mesoscutum* with large conspicuous flange laterally on anterior margin extending antero-dorsally; punctures small (slightly larger than those of *A. intermedius*), very deep and contiguous, becoming rugose antero-laterally. (11) *Mesoscutellum* with medial punctures like those of mesoscutum but separated by about their own diameters and becoming larger and much less dense laterally; large shiny area with few punctures on each side of mid-line. (12) *Metanotum* coarsely and moderately shallowly rugose. (13) *Mesepisternum* moderately coarsely rugose anteriorly, becoming finely rugose posteriorly with largest rugae extending postero-ventrally in arc from anterior margin of metepisternum. (14) *Metepisternum* with coarse, subcontiguous punctures on lower  $\frac{1}{2}$ - $\frac{2}{3}$  becoming horizontally and irregularly rugose on upper  $\frac{1}{3}$ - $\frac{1}{2}$ . (15) *Propodeum* with propodeal carina strong and conspicuous; propodeal shield very coarsely and transversely to irregularly rugose (sometimes with scattered punctures); dorsal area very coarsely and deeply rugose; lateral area with large, deep, subcontiguous punctures and faint rugae (punctures and rugae slightly finer anteriorly than posteriorly). (16) *Wing* hyaline or slightly fuliginous, veins dark brown. (17) *Tegula* transparent amber with yellow on proximal margin and submarginally on anterior portion (some-

times small amount on posterior margin). (18) *Fore leg* yellow with dark brown basally and posteriorly on coxa; femur with brown apical spot dorsally and often with brown streak posteriorly; brown streak posteriorly on tibia. (19) *Middle leg* as fore leg but with coxa dark brown, with brown spot at apex of femur larger, and with dark brown streak on posterior of tibia extending to dorsal surface. (20) *Hind leg* (Fig. 142) with coxa bright metallic green dorsally and posteriorly, yellow ventrally; trochanter dark brown, becoming yellow ventrally; femur yellow with dark brown on proximal margin and with dark brown patch at apex; tibia with dark brown to brown-black streak antero-dorsally on apical  $\frac{1}{2}$ - $\frac{3}{4}$  and with large dark brown spot anteriorly on distal margin. **Metasoma:** (21) *Terga* 2-6 dark brown to brown-black on posterior  $\frac{1}{2}$ - $\frac{2}{3}$  and yellow on anterior  $\frac{1}{2}$ - $\frac{1}{3}$  (often partially concealed by overlap); tergum 1 dark brown to brown-black with yellow band antero-dorsally (often interrupted laterally); very conspicuously punctate with subcontiguous punctures largest on tergum 1, becoming progressively smaller on posterior terga. Pubescence golden to amber anteriorly on tergum 1, laterally on terga 1-7 and dorsally on terga 5-7; very short dorsally on terga 1-4, golden to fulvus on yellow bands and dark brown to brown-black on dark bands. (22) *Sterna* yellow, brown tinged with green on sternum 1 and with transverse bands on posterior margins of sterna 2-5 narrowest on sternum 2, becoming progressively wider (especially medially) posteriorly; sternum 6 with slight proximo-medial bulge but without distinct "button"; pubescence limited to scattered, moderately long, fulvus to golden hairs on exposed areas. (23) *Genitalia* (Figs. 196, 213) with ventral lobes very short and bearing brush of hairs apically.

#### FEMALE (Figs. 43-44)

General coloration of head and mesosoma black or blue-black, pubescence black or fuscous. **Head** (Figs. 43-44): pubescence black or nearly black, becoming fuliginous on gena. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with transverse submarginal yellow band distally (sometimes interrupted medially or entirely absent); large scattered punctures on lower  $\frac{1}{2}$ , becoming smaller and interspersed with short, weak, horizontal rugulae. (3) *Interocular area* with deep, contiguous, moderately small punctures below ocelli, becoming coarsely rugose above antennal sockets, becoming moderately coarsely rugose below antennal sockets; supraclypeal protuberance with deep, moderately small, scattered punctures and weak horizontal rugae. (4) *Vertex* with moderately small, deep, contiguous punctures anteriorly and laterally, becoming smaller and weaker between ocelli; transversely carinate posteriorly. (5) *Gena* with fine, contiguous, parallel carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* amber; very short, almost absent. (7) *Mandible* yellow, becoming amber to ferruginous

on basal half. (8) *Antenna* with scape and pedicel black to brown-black; flagellum brown to brown-black above, becoming amber below. **Mesosoma:** pubescence fuscous (white tomentum between posterior lobe of pronotum and mesepisternum) becoming black on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe acutely pointed, lateral angle projecting antero-laterally; with conspicuous sharp carina extending postero-ventrally from apex of lateral angle; with weak irregular horizontal rugae postero-laterally. Pubescence above lateral angle and posterior lobe black. (10) *Mesoscutum* with conspicuous flange laterally on anterior margin extending antero-dorsally; punctures small (slightly larger than those of *A. intermedius*), very deep and contiguous, becoming rugose antero-laterally. (11) *Mesoscutellum* with punctures small, deep and contiguous medially, becoming widely scattered on shiny lateral area. (12) *Metanotum* coarsely and shallowly rugose with very deep scattered punctures. (13) *Mesepisternum* moderately coarsely rugose anteriorly, becoming more finely rugose laterally and with irregular rugae extending antero-ventrally from anterior margin of metepisternum. (14) *Metepisternum* horizontally rugulose with few interconnecting rugae. (15) *Propodeum* with propodeal carina very strong and conspicuous; propodeal shield with very strong carinae extending dorso-laterally from medial groove; dorsal area with very strong, deep rugae extending postero-laterally from anterior margin (irregular medially); lateral area with numerous weak horizontal carinae anteriorly becoming fewer but larger posteriorly. (16) *Wing* as in ♂. (17) *Tegula* brown to black. (18-20) *Fore, middle and hind legs* brown-black to black; pubescence black dorsally, becoming dark amber below. **Metasoma:** (21) *Terga* black; punctures separated by about their diameters; pubescence very short and appressed dorsally, becoming moderately long and erect anteriorly, laterally and posteriorly; pubescence black with narrow basal band of sparse white tomentum on terga 2-4. (22) *Sterna* brown-black to black with long black hairs scattered on exposed areas.

***Agapostemon boliviensis* n. sp.**

This species is named for the country where it is found.

The male holotype and paratype as well as the allotype are labeled, "BOLIVIA-Beni, Rur-/ renabaque, 175 mts./ 5 October 1956/ (L. Peña)." These types are in the Snow Entomological Museum at the University of Kansas.

**DISTRIBUTION.** This species seems to be sympatric with *A. mourei*. In addition to the types, I have seen specimens in the Snow Entomological Museum with the following labels: "Cristal Mayu./ Chapare, Cochab/ amba Bol. 200 m./ XII-5-49 L E Pena" (2 ♂); same as preceding but collected the next day (2 ♂); "BOLIVIA-Dpto. La Paz/ Alta Marani, N. of/



Rurrenbaque, 10 Nov/ 1956 (L. Peña)" (1 ♂). Two males in the U.S. National Museum have the following labels: "Covendo/ Bolivia/ Wm M Mann// Aug// Mulford/ BioEpl/ 1921-22" and "nr. mouth/ Rio Mapiri/ Sept// Mulford/ Bio Expl."

**DIAGNOSIS.** The male may be distinguished from those of most other species by the presence of a medial "button" at the base of its last visible (6th) sternum (Fig. 137). *Agapostemon boliviensis* is distinguished from the closely related *A. inca* by its lack of large hooked setae on the posterolateral margin of the antepenultimate visible (4th) sternum, from *A. mourei* and *A. inca* by the smaller and more rounded medial plate of its gonostylus, and from *A. intermedius* by its enlarged hind femur, tibia and basitarsus (Fig. 170).

The female may be distinguished from most other species by the acute lateral angle and posterior lobe of its pronotum and by the dense woolly pubescence of its mesoscutum; from those of *A. lanosus* and *A. heterurus* by the yellow maculations on its clypeus and by its more finely branched mesoscutal pubescence; from those of *A. mourei* by its slightly coarser genal striae and its darker pubescence.

#### DESCRIPTION

##### MALE (Figs. 137, 170, 177A, 215)

As in *A. mourei* but head and mesosoma bright metallic green usually with strong, dark copper tints; antenna dark brown to black with scape yellow below; tegula dark brown to brown-black; middle leg brown with narrow yellow streak anteriorly on trochanter and sometimes on tibia, and with yellow anteriorly (and usually posteriorly) on femur; hind leg (Fig. 170) with ventral ridge of basitarsus more convex; sternum 6 (Fig. 137) with proximo-medial projection, or "button," smaller and with each lateral flange approximately  $\frac{1}{2}$  as wide as base (as measured on transverse section through widest part of "button"); genitalia (Figs. 177A, 215)."

##### FEMALE (Figs. 127-128)

As in *A. mourei* but with sculpturing slightly coarser and pubescence darker; metasoma brown anteriorly, becoming black posteriorly and with yellow basally on tergum 3.

**VARIATION.** The color of the head and mesosoma of males ranges from a bright metallic blue-green to a dark coppery luster. Furthermore, the black markings of the appendages and metasoma are often replaced by pale fawn markings. There is no obvious correlation between the color of the head and mesosoma and the color of the markings on the appendages and metasoma.

*Agapostemon centratus* (Vachal)

*Halictus (Agapostemon) centratus* Vachal 1903. Type ♂, Muséum National D'Histoire Naturelle, Paris.

A metasoma, all that remains of the holotype, is dark brown to black with broad bands of white tomentum. I have seen two males labeled "Costa Rica" and both have amber metasomas. The genitalia of the type are indistinguishable from those of the males labeled "Costa Rica." The type is from Haiti and this species resembles the West Indian *A. viridulus* group in sculpturing and genitalia. Like the similarly labeled specimens of *A. aenigma*, the two males labeled "Costa Rica" are probably from the West Indies.

**DIAGNOSIS.** This species is unique in the genus inasmuch as the metasoma resembles that of females of *A. melliventris* in being amber to black with broad bands of white tomentum basally on the terga. The resemblance is so great that Sandhouse misdetermined the two males with amber metasomas as females of *A. melliventris*.

## DESCRIPTION

MALE (Figs. 121-122, 152, 182, 206)

General coloration of head and mesosoma bright metallic green, metasoma amber to black with conspicuous bands of white tomentum. Pubescence of head and mesosoma white to creamy. **Head** (Figs. 121-122): (1) *Labrum* yellow with transparent margin, evenly rounded apically (not acute); basal area with conspicuous median depression. (2) *Clypeus* with shallow punctures separated by nearly twice their diameters; pubescence sparse, short. (3) *Interocular area* shallowly rugose at level of antennal sockets, becoming finely rugulose above, sparsely punctate on supraclypeal protuberance becoming shallowly rugose laterally; pubescence nearly as long as scape medially, becoming shorter laterally and appressed ventrolaterally. (4) *Vertex* with contiguous, fine punctures, becoming rugose behind ocelli; pubescence like that of interocular area. (5) *Gena* with weak, discontinuous, parallel carinulae running postero-dorsally from anteroventral margin; pubescence dense, nearly 1.5× as long as scape postero-medially, becoming shorter anteriorly and laterally. (6) *Malar area* yellow to amber, short, with pubescence white and tomentose. (7) *Mandible* yellow, apical quarter transparent and ferruginous. (8) *Antenna*. Flagellum dark brown above, amber below and on shiny dorsal spot on apex of distal flagellomere; pedicel dark brown above, becoming light brown below; scape yellow below, dark brown above. **Mesosoma**: white pubescence moderately dense and evenly distributed (except pronotum). (9) *Pronotum* with lateral angle and posterior lobe rounded, 8-12 parallel carinulae running postero-ventrally from below lateral angle; pubescence above lateral angle

and posterior lobe like that of mesoscutum, extremely short and fine on postero-lateral area. (10) *Mesoscutum* with fine, contiguous punctures becoming finely rugulose antero-laterally. (11) *Mesoscutellum* shiny with small scattered punctures becoming larger and more numerous on lateral margins. (12) *Metanotum* with very small, sparse punctures medially and with weak, short, lateral carinulae directed postero-laterally. (13) *Mesepisternum* coarsely but shallowly rugose anteriorly, becoming finely rugose posteriorly. (14) *Metepisternum* finely, regularly and horizontally carinate. (15) *Propodeum* rounded posteriorly; propodeal carina absent or very weak and discontinuous; weak, closely parallel carinulae running ventro-laterally from antero-dorsal margin; propodeal shield with few, weak, irregular carinulae running laterally and antero-laterally from mid-line. (16) *Wing* transparent and colorless with radius obviously darker than other veins. (17) *Tegula* transparent with metallic green on proximal margin and faint yellow transverse band. (18-20) *Fore, middle and hind legs* (Fig. 152) amber to fawn, slightly darker on dorsal surfaces of tibiae of middle and hind legs; all coxae metallic green. Pubescence short, creamy to amber. **Meta-soma:** (21) *Terga* transparent amber with subapical brown band on tergum 1; brown band larger, darker and broader on terga 2 and 3 and covering exposed areas of terga 4-7. Broad, basal band of dense white tomentum on terga 2-5; sparse, moderately long, creamy pubescence on anterior surface of tergum 1, ventro-lateral surfaces of terga 1-6, and postero-dorsal surfaces of terga 5-7. (22) *Sterna* transparent, amber, with short creamy pubescence on exposed areas directed posteriorly. (23) *Genitalia* (Figs. 182, 206) with weak parallel carinae dorso-laterally on gonocoxa. Ventral lobes extremely large, cupped and densely fringed with short hairs.

### *Agapostemon chapadensis* Cockerell

*Agapostemon chapadensis* Cockerell 1900. Lectotype ♂, Carnegie Museum.

? *Agapostemon castaneus* Schrottky 1902b. Type ♂? Departamento de Zoologia, São Paulo?

Schrottky (1909b) synonymized the male of this species with *A. chapadensis*. Not having seen a type I cannot dispute his judgment.

? *Agapostemon azarae* Holmberg 1903. Type ♀.

? *Agapostemon argentinus* Holmberg 1903. Type ♀.

? *Agapostemon experiendus* Holmberg 1903. Type ♂.

I have seen the syntypes of *A. chapadensis* and have labeled one male lectoholotype, the other male lectoparatype and the female lectoallotype. All specimens are from Chapada. I selected a male as the lectoholotype because I am unable to distinguish the females of *A. semimelleus* and *A. chapadensis*, although the female lectoallotypes are easily distinguished.

**DISTRIBUTION.** This species is found in the *campos*, or tropical grasslands, of southern Brasil, of Paraguay and of northeastern Bolivia. Unlike



*A. semimelleus*, it has not been found in the river valleys of the eastern slopes of the Andes.

**DIAGNOSIS.** The male may be distinguished from those of most other South American species by the acute lateral angle on its pronotum and lack of a "button" on its last visible sternum (6th). It may be distinguished from males of *A. semimelleus* by the longer distal stylus of its genitalia (Figs. 173-174) and by the greater amount of black on the posterior of its hind femur (Figs. 171-172).

The female cannot be distinguished from that of *A. semimelleus* (cf. *A. semimelleus*, VARIATION) but it may be distinguished from those of other South American *Agapostemon* by the acute upturned flange on its anterior mesoscutal margin and lack of basal yellow bands on its metasomal terga.

#### DESCRIPTION

##### MALE (Figs. 172-173, 219)

General color of head and mesosoma bright metallic green, metasoma banded with black and yellow. Like male of *A. semimelleus* but for the following features. **Mesosoma:** (18) *Fore leg* yellow with brown (sometimes with slight metallic tints) posteriorly on trochanter, femur and tibia. (19) *Middle leg* yellow with brown on coxa, basitarsus, posterior of trochanter and tibia, and posterior of apical  $\frac{1}{2}$  of femur. (20) *Hind leg* (Fig. 172) yellow with upper  $\frac{1}{2}$  of coxa metallic, with brown on trochanter, on posterior and apex of femur, on posterior and antero-dorsal regions of tibia, and on all but antero-ventral region of basitarsus. **Metasoma:** (22) *Sterna* 2-5 brown with amber posterior margins and sometimes with yellow on anterior margins, sternum 1 amber with metallic tints basally, and sternum 6 amber becoming brown on anterior margin. (23) *Genitalia* (Figs. 173, 219) ventral lobes very short with apical brush of long stiff hairs. Distal stylus about twice as long as width of medial plate.

##### FEMALE

Like that of *A. semimelleus* (cf. *A. semimelleus*, VARIATION).

#### *Agapostemon cockerelli* Crawford

*Agapostemon cockerelli* Crawford 1901. Type ♀, U.S. National Museum.

*Agapostemon martini* Cockerell 1927. Males only (misidentified).

I have examined the types of *Agapostemon cockerelli* Crawford and *Agapostemon femoratus* Crawford (1901) in Washington, D.C. and, contrary to the opinions of Sandhouse (1936) and Michener (1951), find them specifically distinct. The males (paratypes) of *Agapostemon martini* Cockerell (1927) were misdetermined and belong in *A. cockerelli*. *Nomia cillaba* Cameron (1902), listed by Michener (*In* Muesebeck, et al., 1951) as a

possible synonym of *Agapostemon cockerelli*, does not belong in the genus *Agapostemon* (cf. *Excluded Species*).

**DISTRIBUTION** (Fig. 2). *Agapostemon cockerelli* occurs as far north as Pat Creek, Park Co., Wyoming; as far south as Petlalcingo, Puebla, Mexico; as far east as Tehuacan, Mexico; and as far west as Wickenburg, Maricopa Co., Arizona. Most abundant at elevations of 4,500-7,500 ft. (1,372-2,286 m), this species has been collected as high as 8,000 ft. (2,438 m) on Pine Top Mountain, Culberson Co., Texas, and as low as 2,100 ft. (640 m) in Big Bend National Park, Brewster Co., Texas. In Mexico it is apparently restricted to the central plateau, where it has been collected as high as 7,300 ft. (2,225 m) 20 miles north of Zacatecas, Zacatecas, and as low as 1,850 ft. (564 m) in Boquillas del Carmen, Coahuila. In the United States females of *A. cockerelli* have been collected from March through October and males from April through November. In Mexico females have been collected from June through October and males from April through December.

**DIAGNOSIS.** The male may be distinguished from males of many species by its toothed and conspicuously inflated hind femora, the lack of an apical stylus on its gonostylus, or by its nearly hyaline wings; from males of *A. radiatus* by the basal ridge on its basitarsus; and from males of *A. femoratus* by the much smaller basal ridge on its hind basitarsus (Figs. 162-163). The female may be distinguished from females of many species by its metallic green metasomal terga, its coarsely punctate or rugose mesoscutum without punctures of two distinct sizes, and its nearly hyaline wings; and from females of *A. femoratus* by its largely punctate (rugose only anteriorly and laterally) mesoscutum. The female cannot be morphologically differentiated from females of *A. radiatus* but may be distinguished by its southwestern distribution.

#### DESCRIPTION

##### MALE (Figs. 107-108, 162)

General color of head and mesosoma bright green to blue-green, metasoma with black and yellow bands. **Head** (Figs. 107-108): pubescence white, becoming pale yellowish on vertex and sometimes on interocular area; more dense than in *A. radiatus*. (1) *Labrum* as in *A. texanus*. (2-5) *Clypeus*, *interocular area*, *vertex* and *gena* as in *A. radiatus* but with slightly coarser and shallower sculpturing. (6-7) *Malar area* and *mandible* as in *A. radiatus*. (8) *Antenna* as in *A. radiatus* but with underside of flagellum pale amber to yellowish and with upper side of apical half of apical flagellomere pale amber to yellow. **Mesosoma**: pubescence white, commonly becoming yellowish on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe slightly more angular than in *A. radiatus* and with sculpturing weaker than in *A. radiatus*. (10-15) *Mesoscutum*,

*mesoscutellum*, *metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. radiatus* but with sculpturing shallower and slightly finer. (16-17) *Wing* and *tegula* as in *A. radiatus* but slightly paler. (18-19) *Fore* and *middle legs* as in *A. radiatus* but with brown maculations reduced (may be absent on fore leg). (20) *Hind leg* (Fig. 162) as in *A. radiatus* but with trochanter yellow with femur and tibia more swollen and with small basal ridge and apical groove on basitarsus. **Metasoma:** (21-22) *Terga* and *sterna* as in *A. radiatus* but with dark brown or black areas reduced, and with stronger metallic tints postero-laterally on terga 3-4. (23) *Genitalia* indistinguishable from those of *A. femoratus*.

#### FEMALE (Figs. 59-60)

General coloration of head, mesosoma and metasoma bright metallic green to blue-green. **Head** (Figs. 59-60): pubescence white, commonly with faint yellow tints on vertex. (1) *Labrum* as in *A. texanus*. (2-4) *Clypeus*, *interocular area* and *vertex* as in *A. radiatus* but with sculpturing slightly shallower and slightly finer. (5) *Gena* as in *A. radiatus* but with genal carinae usually slightly coarser. (6-7) *Malar area* and *mandible* as in *A. radiatus*. (8) *Antenna* as in *A. radiatus* but often paler on underside of flagellum and with yellowish amber at base and apex of scape. **Mesosoma:** pubescence white, becoming slightly yellowish to fuliginous on mesonotum and metanotum. (9) *Pronotum* as in *A. radiatus* but with sculpturing slightly weaker. (10-13) *Mesoscutum*, *mesoscutellum*, *metanotum*, *mesepisternum* as in *A. radiatus* but with sculpturing slightly coarser. (14) *Metepisternum* as in *A. radiatus* but irregularly anastomosing carinae with greater tendency to rugose condition. (15) *Propodeum* as in *A. radiatus* but with slightly finer rugae on propodeal shield; dorsal surface with much shallower sculpturing and more commonly rugose or with more frequently anastomosing carinae. (16) *Wing* as in *A. radiatus* but slightly paler. (17) *Tegula* as in *A. radiatus* ♂ but slightly paler. (18-20) *Fore*, *middle* and *hind legs* as in *A. radiatus* but with pubescence paler; with yellow markings on fore leg and middle leg; and usually with more extensive yellow markings anteriorly on fore tibia. **Metasoma:** (21) *Terga* as in *A. radiatus* but bands of white tomentum on terga 2-4 slightly broader and more dense. (22) *Sterna* as in *A. radiatus* but rarely with weak metallic tints on sternum 4.

#### *Agapostemon coloradinus* (Vachal)

*Agapostemon coloradensis* Crawford 1901. Lectotype\* ♀, U.S. National Museum.

*Halictus (Agapostemon) coloradinus* Vachal 1903.

When Vachal placed *Agapostemon* in the genus *Halictus*, *Agapostemon*

\*The specimen is labeled "Lectotype." Although I have not been able to find a lectotype designation in the literature, I accept this specimen as a lectotype and formalize it by so designating it here.

*coloradensis* Crawford became a junior secondary homonym of *Agochlora coloradensis* Titus. Vachal renamed the former, *Halictus (Agapostemon) coloradinus*. Few workers agreed with Vachal's placement of *Agapostemon* as a subgenus of *Halictus*, but the International Code of Zoological Nomenclature (anonymous, 1964) states (Article 59c) that secondary homonyms rejected before 1961 cannot be revived, contrary opinions (Cockerell, 1937a and Michener, *In* Muesebeck, et al., 1951) notwithstanding.

Sandhouse (1936) included *Agapostemon tyleri* Cockerell and *Agapostemon martini* Cockerell in *Agapostemon coloradinus* (Vachal), but having examined the types I find her decisions unjustified (cf. *A. tyleri*).

DISTRIBUTION (Fig. 3). This is by far the rarest of the North American species and its range is more restricted than that of any other North American species. I have seen fewer than 300 specimens, from the high, western plains of South Dakota, Nebraska, Kansas, Oklahoma and Texas and from both the plains and mountains of New Mexico, Colorado, Wyoming and central Utah. Females have been collected from May through October and males from August through October. Specimens have been collected as low as 2,060 ft. (628 m) in Rush Co., Kansas and as high as 10,600 ft. (3,231 m) at Echo Lake, Mt. Evans, Colorado.

DIAGNOSIS. The male may be distinguished from all other North American species except *A. tyleri* by the lack of yellow maculations on its dark brown to black metasomal sterna; from *A. tyleri* by its larger size, by the brown streak on the central  $\frac{2}{3}$  of the length of the posterior surface of its hind tibia (Figs. 159-160), and by its more slender penis valve which has a conspicuous row of hairs on its dorsal crest (Figs. 226-227). The female may be distinguished from many other species occurring north of Mexico by its black metasoma and the lack of yellow on its clypeus; from *A. virescens* by its finer and more numerous genal carinulae (2-3 per 0.25 mm in *A. virescens* and 5-6 per 0.25 mm in *A. coloradinus*); and from *A. tyleri* by its brown wings, paler tegulae and less shiny supraclypeal protuberance. This species is very close phenetically to *A. tyleri*.

#### DESCRIPTION

MALE (Figs. 99-100, 160, 185, 199, 226)

General coloration of head and mesosoma bright metallic blue to greenish blue, metasoma with black and pale yellow to creamy bands. **Head** (Figs. 99-100): pubescence snowy white. (1) *Labrum* as in *A. texanus* but more rounded at apex. (2) *Clypeus* as in *A. virescens* but punctures shallower and pubescence more dense. (3) *Interocular area* with coarse contiguous punctures (some specimens finely rugose around antennal sockets); supraclypeal protuberance as in *A. virescens*. (4) *Vertex* as in *A. virescens*. (5) *Gena* as in *A. virescens* but with carinae much finer. (6) *Malar area* yellow,

never amber; short. (7) *Mandible* as in *A. virescens*. (8) *Antenna* dark brown to brown-black above with apex of apical flagellomere amber; flagellum amber below and underside of scape and pedicel yellow (scape of some specimens from Boulder, Colorado, area black with yellow apically on underside). **Mesosoma:** pubescence snowy white. (9) *Pronotum* as in *A. virescens* but with weaker sculpturing. (10) *Mesoscutum* as in *A. virescens* but with finer punctures and with anterior margin punctate. (11-13) *Mesoscutellum*, *metanotum* and *mesepesternum* as in *A. virescens* but with finer sculpturing. (14) *Metepisternum* rugose or with irregularly anastomosing carinae. (15) *Propodeum* with propodeal carina weak, often broadly interrupted laterally; propodeal shield finely and weakly rugulose; finely rugose dorsally and postero-laterally becoming punctate antero-laterally. (16) *Wing* as in *A. virescens* but paler and with darker radial vein. (17) *Tegula* as in *A. virescens* but slightly paler and transparent. (18-19) *Fore* and *middle legs* as in *A. virescens* but with brown-black markings of tibiae and femora more extensive and sometimes with yellow apically on ventral surface of trochanter. (20) *Hind leg* (Fig. 160) as in *A. virescens* but tibia with brown streak on apical  $\frac{1}{2}$  of posterior surface, femur with brown streak entire length of posterior surface, trochanter usually with yellow spot apically on antero-ventral surface, and tooth on femur directed distally. **Metasoma:** (21) *Terga* brown-black with creamy bands on basal halves of terga 2-5 and centrally on tergum 1 (commonly interrupted medially on tergum 1); pubescence short dorsally on terga 1-4, black on dark bands and white on creamy bands; moderately long and white elsewhere. (22) *Sterna* brown to brown-black, usually with faint carina medially on apical  $\frac{1}{2}$  of sternum 6; moderately long white hairs scattered on exposed areas. (23) *Genitalia* (Figs. 185, 199, 226) as in *A. virescens* but with smaller fold on medial plate of gonostylus and with conspicuous hairs on prominent dorsal crest of penis valve.

#### FEMALE (Figs. 49-50)

General coloration of head and mesosoma bright metallic blue to blue-green, metasoma black with white hair bands. **Head** (Figs. 49-50): (1) *Labrum* as in *A. texanus* but with distal keel slightly broader. (2-4) *Clypeus*, *interocular area* and *vertex* as in *A. virescens* but with sculpturing slightly finer. (5) *Gena* as in *A. virescens* but with much finer and more numerous (5-6 per 0.25 mm) carinulae. (6) *Malar area* dark ferruginous to brown-black; very short, almost absent. (7) *Mandible* very dark amber with apical  $\frac{1}{3}$  darker ferruginous and base almost black (with very faint metallic tints on some specimens). (8) *Antenna* brown-black, lower half of flagellum usually slightly paler brown than upper  $\frac{1}{2}$ . **Mesosoma:** snowy white pubescence sometimes very slightly fuliginous on mesonotum and meta-



notum. (9-15) *Pronotum*, *mesoscutum*, *mesoscutellum*, *metanotum*, *mese-pisternum*, *metepisternum* and *propodeum* as in *A. virescens* but with sculpturing slightly shallower and finer. (16) *Wing* brown in contrast to that of male; unlike that of *A. splendens*, not markedly darker on distal borders; radius brown-black, other veins and pterostigma dark brown. (17) *Tegula* as in *A. virescens*. (18-20) *Fore*, *middle* and *hind legs* as in *A. virescens* but with pubescence basally on antero-dorsal surface of hind leg slightly paler (usually amber but may be dark brown). **Metasoma:** (21-22) *Terga* and *sterna* as in *A. virescens*.

### *Agapostemon columbi* n. sp.

This species is named after Christopher Columbus who first landed in the New World on San Salvador Island (=Watling I.).

I have seen one male and one female of *A. columbi*. The male is labeled, "Watlings [*sic*] Is./Bahama Islands/W. W. Worthington/III.13.1909//Carn. Mus./Acc. 3960." The female is labeled, "Watling Is./Bahama Islands/W. W. Worthington/III.20.1909//Carn. Mus./Acc. 3960." The male holotype and the allotype are both at the Carnegie Museum, Pittsburgh, Pennsylvania.

**DIAGNOSIS.** The female may be distinguished from *A. viridulus*, *A. obscuratus*, *A. hispaniolicus*, *A. swainsonae*, *A. alayoi* and *A. kohliellus* by its metallic metasomal terga; from *A. sapphirinus*, *A. cyaneus* and *A. ochromops* by its lack of milky yellowish eyes and pterostigma; from *A. viequesensis* by the metallic green tints on the base of its mandible; from *A. poeyi* and *A. insularis* by its lack of metallic green tints on metasomal sterna 3 and 4; and from *A. aenigma* by the golden (rather than white) pubescence on the undersides of its hind femur and tibia.

The male may be distinguished from *A. viridulus*, *A. obscuratus*, *A. hispaniolicus*, *A. swainsonae* and *A. cubensis* by its lack of an elongate clypeal area; from *A. kohliellus* and *A. centratus* by the tooth on its hind femur; from *A. sapphirinus*, *A. cyaneus* and *A. ochromops* by its lack of milky to yellowish eyes and pterostigma; from *A. insularis*, *A. jamaicensis* and *A. poeyi* by its lack of metallic green or blue medially on metasomal tergum 3; and from *A. viequesensis* by its conspicuous metallic green tints medially on metasomal terga 4-5. Both males and females of *A. columbi* are slightly larger than those of other members of the *A. viequesensis* species group.

### DESCRIPTION

#### MALE

General coloration of head and mesosoma bright metallic blue-green, metasoma dark brown with narrow yellow bands. **Head:** as in *A. viequesensis* but with pubescence amber on interocular area and vertex.



**Mesosoma:** pubescence on mesonotum and metanotum pale amber, elsewhere pale yellowish to creamy. (9) *Pronotum* as in *A. viequesensis* but with fewer and coarser horizontal carinae on postero-lateral area, and with lateral angle and posterior lobe slightly more angular. (10-14) *Mesoscutum*, *mesoscutellum*, *metanotum*, *mesepisternum* and *metepisternum* as in *A. viequesensis* but with coarser sculpturing as in *A. poeyi* (but not as coarse). (15) *Propodeum* with sculpturing much coarser than in *A. viequesensis* and with prominent carinae extending postero-laterally from posterior margin of metanotum. (16) *Wing* as in *A. viequesensis* but slightly darker and with darker veins and pterostigma. (17) *Tegula* as in *A. viequesensis* but with transparent amber portion slightly darker. (18-20) *Fore*, *middle* and *hind legs* as in *A. viequesensis*. **Metasoma:** pubescence as in *A. viequesensis*. (21) *Terga*. Tergum 1 dark amber on anterior  $\frac{1}{2}$ , dark brown on posterior dorsal area, and with yellow band centrally, broadly interrupted medially. Terga 2-3 dark brown with yellow band on anterior  $\frac{1}{3}$ . Terga 4-7 like 2-3 but with conspicuous metallic tints on dark brown areas. (22) *Sterna* as in *A. viequesensis*. (23) *Genitalia* as in *A. viequesensis* but with apex of distal stylus on gonostylus slightly enlarged, but not so much as in *A. poeyi*.

## FEMALE

General coloration of head, mesosoma and metasoma bright metallic blue-green to blue (metasoma with purple-brown tints). **Head:** pubescence white, only very faintly fuliginous on vertex. (1) *Labrum* as in *A. hispaniolicus* (cf. *A. viequesensis*). (2-5) *Clypeus*, *interocular area*, *vertex* and *gena* as in *A. viequesensis* but with sculpturing much coarser, although not as coarse as in *A. poeyi*. (6-8) *Malar area*, *mandible* and *antenna* as in *A. viequesensis* but with metallic spot at base of mandible. **Mesosoma:** as in *A. viequesensis* but pubescence paler on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe slightly more angular than in *A. viequesensis*, although not so much as in *A. poeyi*; and with postero-lateral horizontal carinae fewer in number and coarser than in *A. viequesensis* although not as few and as coarse as in *A. poeyi*. (10) *Mesoscutum* with punctures slightly coarser than in *A. viequesensis*, but not nearly as coarsely sculptured as in *A. poeyi*. (11) *Mesoscutellum* as in *A. viequesensis* but less shiny and with punctures deeper and denser. (12-15) *Metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. poeyi* but with finer sculpturing, although not as fine as in *A. viequesensis*. (16) *Wing* as in ♂. (17) *Tegula* as in *A. viequesensis*. (18-20) *Fore*, *middle* and *hind legs* as in *A. viequesensis* but with pubescence amber, becoming brown-black antero-dorsally on tibia and basitarsus (not as dark on latter) of hind leg. **Metasoma:** as in *A. viequesensis* but with metallic areas bluer and nonmetallic areas darker.

**Agapostemon cubensis** n. sp.

This species is named for the island of Cuba where it is found.

I have seen a single male labeled, "Cuba 5.K./S. of Pinar Rio, Sept. 12-23 '13." The type is in the American Museum of Natural History, New York.

**DIAGNOSIS.** The male of this species may be distinguished from *A. kohliellus* and *A. centratus* by its toothed hind femora; from *A. viridulus*, *A. obscuratus* and *A. hispaniolicus* by its pale amber and brown banded basal metasomal terga; from *A. swainsonae* by its small and narrowly grooved basitarsal ridge; and from males of *A. poeyi*, *A. viequesensis*, *A. cyaneus*, *A. sapphirinus*, *A. ochromops*, *A. columbi*, *A. insularis* and *A. jamaicensis* by its elongate clypeal area.

**DESCRIPTION****MALE** (Figs. 119-120, 149)

General coloration of head and mesosoma shiny, metallic blue and green, metasoma pale amber and brown. **Head** (Figs. 119-120): pubescence white. (1) *Labrum* as in *A. viridulus* but white and darkened only centrally. (2) *Clypeus* metallic blue above, white below; elongate as in *A. viridulus*; shiny and sparingly punctate medially, becoming more densely punctate laterally; pubescence sparse. (3) *Interocular area* metallic blue; shallow contiguous punctures below median ocellus, shallowly and finely rugose just above and at level of antennal sockets, becoming shiny with scattered punctures below antennal sockets, supra-clypeal protuberance shiny and sparsely punctate and with weak transverse carinulae; pubescence between antennal sockets about  $\frac{2}{3}$  as long as scape, becoming shorter laterally, dorsally and ventrally; tomentose ventro-laterally, near malar area. (4) *Vertex* metallic blue, changing to blue-green posteriorly; punctures very fine (finer than in *A. viridulus*), shallow anteriorly and laterally, becoming rugose posteriorly; area between ocelli sparsely and shallowly punctate; pubescence white, not fuliginous as in *A. viridulus*. (5) *Gena* metallic blue-green in contrast to metallic blue of clypeus, interocular area and vertex; rugae as in *A. viridulus* but weaker; pubescence as long as scape postero-medially, becoming shorter laterally, anteriorly and dorsally. (6-8) *Malar area*, *mandible* and *antenna* as in *A. viridulus* but with white replacing yellow. **Mesosoma**: pubescence as in *A. viridulus* but white on mesonotum and metanotum. (9) *Pronotum* as in *A. viridulus* but blue dorso-medially, becoming blue-green ventro-laterally. (10) *Mesoscutum* metallic blue with very fine punctures, slightly shallower and less dense than in *A. viridulus* and becoming weakly rugulose anteriorly. (11) *Mesoscutellum* metallic blue-green, punctures as in *A. viridulus* but slightly shallower. (12) *Metanotum* metallic blue-green, with sculpturing as in *A. viridulus*.

(13) *Mesepisternum* metallic blue-green antero-dorsally becoming green posteriorly and ventrally, with sculpturing as in *A. viridulus* but slightly coarser. (14) *Metepisternum* metallic blue-green dorsally, becoming green ventrally, with sculpturing as in *A. viridulus* but slightly coarser. (15) *Propodeum* metallic green, with sculpturing as in *A. viridulus*. (16) *Wing* as in *A. viridulus* but with veins not as dark. (17) *Tegula* as in *A. viridulus* but transparent portion amber and metallic tints blue. (18-19) *Fore and middle legs* as in *A. viridulus* but with pale amber replacing dark brown. (20) *Hind leg* (Fig. 149) with coxa and trochanter as in *A. viridulus*; femur amber with white antero-ventrally, on basal  $\frac{2}{3}$  antero-dorsally, and on postero-ventral margin between tooth and distal margin; tibia pale amber ventrally becoming pale brown dorsally; tarsus amber. Femur less swollen than in *A. viridulus*, basitarsus with narrow basal ridge much smaller than in *A. viridulus*, apical groove much narrower and shallower than in *A. viridulus*. Pubescence as in *A. viridulus*. **Metasoma:** (21) *Terga*. Tergum 1 pale amber with narrow band of pale brown anteriorly on dorsal surface; tergum 2 pale amber with central brown band darker and broader than on preceding tergum 1; tergum 3 with broad dark brown band centrally, pale amber basally, and brown apically; terga 4-7 brown-black basally, becoming brown apically. Moderate to long white hairs scattered on ventro-lateral margins, anteriorly on tergum 1, and posteriorly on terga 5-7; short, dense, simple, prostrate hairs on terga 1-5 brown and inconspicuous; thin, white inconspicuous tomentum basally on terga 1-6 (usually hidden by preceding terga). (22) *Sterna* as in *A. viridulus* but amber with subapical, pale brown band narrow on sternum 3, becoming broader and darker on sternum 4-6. (23) *Genitalia* (examined dry) as in *A. viridulus* but with about  $\frac{1}{2}$  as many grooves on gonocoxa.

#### *Agapostemon cyaneus* n. sp.

The name of this species refers to the dark blue color of the female.

I have seen ten specimens (7 ♂, 3 ♀) of *A. cyaneus*. The female holotype, the allotype and seven paratypes are labeled, "Bahamas/Crooked Isl./1-2 Mar//Utowana/Exp. 1934," and one male paratype is labeled, "Bahamas/Crooked Isl./20-II//Greenway/coll." All of the types are in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

**DIAGNOSIS.** Both males and females may be distinguished from all other West Indian species, except *A. sapphirinus* and *A. ochromops*, by their milky to yellowish eyes and pterostigma. The male of *A. cyaneus* may be distinguished from *A. sapphirinus* and *A. ochromops* by its pedicel which is yellow to amber below (not dark brown). The female of *A. cyaneus* may be distinguished from *A. ochromops* by its very dark blue color, and from *A. sapphirinus* by its finely carinate gena.

## DESCRIPTION

## MALE

General coloration of head and mesosoma dark metallic green to blue, metasoma black with pale yellow bands. **Head:** darker than in *A. viequesensis* and with paler eyes; pubescence as in *A. viequesensis*. (1-7) *Labrum, clypeus, interocular area, vertex, gena, malar area* and *mandible* as in *A. viequesensis*. (8) *Antenna* as in *A. viequesensis* but with black on upper surface replaced by yellow on distal  $\frac{1}{2}$  of apical flagellomere and basal  $\frac{1}{3}$ - $\frac{1}{4}$  of scape, with underside of flagellum pale amber to yellow, and with underside of scape dark brown to black. **Mesosoma:** pubescence as in *A. viequesensis*. (9-15) *Pronotum, mesoscutum, mesoscutellum, metanotum, mesepisternum, metepisternum* and *propodeum* as in *A. viequesensis* but with very slightly coarser sculpturing. (16) *Wing* as in *A. viequesensis* but with pale yellow pigment on pterostigma and underside of larger veins. (17) *Tegula* as in *A. viequesensis* but with amber replaced by dark brown. (18-20) *Fore, middle and hind legs* as in *A. viequesensis* but with brown-black replacing amber, with yellow areas paler, with brown-black posterodorsally on apex and base of middle femur (and sometimes fore femur), and with average size of basal ridge of basitarsus slightly greater. **Metasoma:** pubescence as in *A. viequesensis*. (21) *Terga* brown-black with narrow, pale yellow bands basally on terga 2-7 (those on posterior terga usually hidden by overlap), and centrally on tergum 1 (often interrupted medially); apex of pygidium nearly as acute as in *A. ochromops* (Fig. 225). (22) *Sterna* as in *A. viequesensis* but brown-black to amber, and sometimes with metallic spot medially on transverse submarginal ridge of sternum 4. (23) *Genitalia* as in *A. poeyi* but distal stylus on gonostylus not as swollen at apex (cf. *A. viequesensis*).

## FEMALE

General coloration of head, mesosoma and metasoma very dark metallic bluish purple. **Head:** as in *A. viequesensis* but with eyes whitish, pubescence wholly white, mandibles brown-black with metallic tints at base and ferruginous apically. **Mesosoma:** as in *A. viequesensis* but with pubescence of mesonotum and metanotum white and fuliginous dorsally on middle tibia, hind tibia and apex of hind femur; with wings as in  $\delta$ ; and with tegula brown-black with metallic tints antero-basally. **Metasoma:** as in *A. viequesensis* but with basal bands of white tomentum on terga broader and denser, and with sterna very dark brown with faint metallic tints.

*Agapostemon erebus* n. sp.

This species is named after the Greek god Erebus, personification of darkness and brother of Night.

The female holotype is in the California Academy of Sciences, San Francisco. It is labeled, "El Salvador/Mt. San Salvador/VII-8-1963//M. E. Irwin & D. Q. Cavagnaro/Collectors." A second female is in the University of Kansas collection labeled, "Guatemala 6.3 mi./NE. Escuintla/30 July 1966/U. Kansas Mex. Exped."

**DIAGNOSIS.** *A. erebus* may be distinguished from the similarly colored females of *A. atrocaeruleus* by its rounded lateral pronotal angle and its coarse genal carinae. It may be distinguished from those females of *A. nasutus* with dark blue head and thorax by the prominent carina running postero-ventrally from the lateral angle of its pronotum, by the lack of yellow on the posterior lobe of its pronotum, and by its coarse genal carinae. It seems most closely related to *A. leunculus* but differs from females of this species by its blue-black head and thorax and shiny lateral area on its mesoscutellum.

#### DESCRIPTION

##### FEMALE

General coloration of head and mesosoma very dark blue to black and only slightly metallic, metasoma black with narrow bands of white pubescence dorsally. **Head:** (1-4) *Labrum*, *clypeus*, *interocular area* and *vertex* as in *A. nasutus* but with pubescence predominantly black. (5) *Gena* with coarse, parallel and anastomosing carinae and whitish pubescence as in *A. leunculus*. (6) *Malar area* black, short. (7) *Mandible* yellow basally, becoming ferruginous on apical  $\frac{2}{3}$ . (8) *Antenna* as in *A. leunculus*. **Mesosoma:** (9) *Pronotum* as in *A. nasutus* but dark blue and with prominent carina running postero-ventrally from lateral angle. (10) *Mesoscutum* dark purple-blue marginally, dull green-black centrally; sculpturing as in *A. nasutus* but slightly finer; pubescence black. (11) *Mesoscutellum* dark purple-black; punctuation as in *A. nasutus* but with lateral shiny area more shiny and conspicuous; pubescence black. (12) *Metanotum* dark purple-black, rugulose; pubescence black. (13) *Mesepisternum* purple-black; sculpturing as in *A. leunculus*; pubescence dark fuliginous on dorsal  $\frac{1}{3}$ , becoming white below. (14-15) *Metepisternum* and *propodeum* dark blue, sculpturing as in *A. nasutus* but slightly coarser; pubescence white, sparse except around and posterior to propodeal spiracle. (16) *Wing* transparent, not darkened apically, radius scarcely darker than other veins. (17) *Tegula* black, dark transparent brown postero-laterally. (18) *Fore leg* brown-black with small yellow spot at base of tibia; pubescence of coxa and trochanter white, remainder dark brown to black. (19-20) *Middle* and *hind legs* brown-black; pubescence similar in color to that of fore leg, but scopal hairs creamy. **Metasoma:** (21-22) *Terga* and *sterna* as in *A. leunculus* (on the holotype the normally hidden, pale brown basal areas of terga are exposed).



**Agapostemon femoratus** Crawford

*Agapostemon femoratus* Crawford 1901, Type ♂, U.S. National Museum.

*Agapostemon californicus* Crawford 1901. Females only (misidentified).

Sandhouse (1936) and Michener (1951) both considered *A. femoratus* synonymous with *A. cockerelli* Crawford (1901), but after examining the types of both species in Washington, D.C., I concluded that they are specifically distinct. The females (paratypes) of *Agapostemon californicus* Crawford (1901) were misdetermined and belong in *A. femoratus*.

**DISTRIBUTION.** *Agapostemon femoratus* occurs as far north as Chilcotin, British Columbia, Canada; as far south as San Vicente, Baja California, Mexico; as far west as the coast of California; and as far east as Williston, North Dakota. In the northern part of the range (Washington), females have been collected from April through October and males from June through October. In California south of Los Angeles, females have been collected from February through November, and males in March and May through November. This species is equally abundant at high and low elevations. *A. femoratus* has been collected as high as 10,150 ft. (3,094 m) at Blanco's Corral, Mono Co., California; 10,000 ft. (3,048 m) at Blue Ridge Fire Lookout, Fremont Co., Wyoming; 9,200 ft. (2,804 m) at Warner Ranger Station, Grand Co., Utah; and 8,600 ft. (2,541 m) on Hart Mountain, Lake Co., Oregon. (See map, Fig. 4.)

**DIAGNOSIS.** The male may be distinguished from many other species by its conspicuously inflated and toothed hind femora, the large and conspicuous apical groove on its hind basitarsus, or its nearly hyaline wings; from *A. radiatus* by the large basal ridge on its basitarsus; and from *A. cockerelli* by its much larger basal ridge on its hind basitarsus and much more inflated hind leg (Figs. 162-163). The female may be distinguished from other species by its metallic green metasomal terga or its coarsely rugose mesoscutum.

**DESCRIPTION****MALE** (Figs. 101-104, 163, 194, 202)

General color of head and mesosoma bright metallic green, metasoma with black and yellow bands. **Head** (Figs. 101-104): pubescence white, usually yellowish on vertex and often pale yellow on interocular area, denser than in *A. radiatus*. (1) *Labrum* as in *A. texanus*. (2-7) *Clypeus*, *interocular area*, *vertex*, *gena*, *malar area* and *mandible* as in *A. radiatus*. (8) *Antenna* as in *A. radiatus* but with underside of flagellum pale amber to yellowish and with upper side of distal 1/2 of apical flagellomere pale amber to yellow. **Mesosoma**: pubescence white, commonly becoming yellowish on mesonotum and metanotum. (9) *Pronotum* as in *A. radiatus* but with lateral angle and posterior lobe slightly more angular, and sculp-

turing weaker. (10-15) *Mesoscutum*, *mesoscutellum*, *metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. radiatus*, but with sculpturing slightly shallower. (16-17) *Wing* and *tegula* as in *A. radiatus* but paler. (18) *Fore leg* as in *A. radiatus* but lacking brown stripe on tibia. (19) *Middle leg* as in *A. radiatus* but with brown tibial stripe very reduced. (20) *Hind leg* (Fig. 163) as in *A. radiatus* but with trochanter yellow; brown stripe on tibia reduced; femur, tibia and basitarsus swollen (femur subglobose); and basitarsus with very large, slightly sinuate basal ridge and large broad apical groove. **Metasoma:** (21-22) *Terga* and *sterna* as in *A. radiatus* but with dark brown or black areas reduced, and with stronger metallic tints postero-laterally on terga 3-4. (23) *Genitalia* (Figs. 194, 202) with gonocoxite partially fused with gonobase; gonostylus with large medial plate but lacking apical and basal styli; ventral lobe of gonocoxite moderately large and with distal fringe of hairs.

#### FEMALE (Figs. 57-58)

General coloration of head, mesosoma and metasoma bright metallic blue-green to blue. **Head** (Figs. 57-58): pubescence white, commonly very pale yellow on vertex. (1) *Labrum* as in *A. texanus*. (2-4) *Clypeus*, *interocular area* and *vertex* as in *A. radiatus* but with sculpturing slightly deeper and more coarse. (5) *Gena* as in *A. radiatus*. (6) *Malar area* dark brown to brown-black; short. (7) *Mandible* as in *A. radiatus* but with pigment creamy and less opaque. (8) *Antenna* as in *A. radiatus* but with flagellum slightly paler on underside. **Mesosoma:** pubescence white, becoming very faintly yellowish on some specimens. (9) *Pronotum* as in *A. radiatus* but with slightly finer sculpturing. (10) *Mesoscutum* very coarsely and deeply rugose, becoming coarsely and contiguously punctate postero-medially. (11-15) *Mesoscutellum*, *metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. radiatus* but with sculpturing slightly coarser; dorsal area of propodeum with carinae more commonly anastomosing or rugose. (16) *Wing* as in *A. radiatus*. (17) *Tegula* as in *A. radiatus* ♂ but much paler. (18-20) *Fore*, *middle* and *hind legs* as in *A. radiatus*. **Metasoma:** (21) *Terga* as in *A. radiatus*. (22) *Sterna* as in *A. radiatus* but darker and never with metallic tints on sternum 4.

#### *Agapostemon heterurus* Cockerell

*Agapostemon heterurus* Cockerell 1917 (a). Type ♀, U.S. National Museum.

In addition to the type and paratype, I have seen a third specimen of *A. heterurus*. All three of these specimens are females; all are in the U.S. National Museum; all are labeled, "Palcazul Peru//Collection/Rosenberg."

**DIAGNOSIS.** The female may be distinguished from most other species by the acute lateral angle and posterior lobe of its pronotum; from *A. mourei* and *A. boliviensis* by the lack of yellow on its clypeus and by its less finely

branched mesoscutal pubescence; from *A. lanosus* by its finer genal striae and its dark metallic blue-green head and mesosoma.

**DESCRIPTION.** Female as in *A. mourei* but head and mesosoma dark metallic blue to blue-green; clypeus lacking yellow; pubescence on meso- and metanotum less dense and woolly; tegulae dark brown; metasomal terga often with dark brown bands centrally.

### *Agapostemon hispaniolicus* n. sp.

This species is named for the island of Hispaniola where it occurs.

The male holotype is labeled, "Port-au-Prince/& vic., Haiti/3-X 1934/Darlington." The allotype is labeled, "Manneville/Haiti/Nov 16-17, '34/Darlington." The types in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

**DISTRIBUTION.** In addition to the holotype and allotype, I have seen specimens from Santo Domingo (2 ♀) and Samana (1 ♂, June) in the Dominican Republic; and from La Moriniere (1 ♀, March, 125 ft.) and Port au Prince (1 ♀, April, 300 ft.; 1 ♂) in Haiti.

**DIAGNOSIS.** The male may be distinguished from other West Indian species, except *A. viridulus* and *A. obscuratus*, by its black metasomal terga and toothed hind femora; from *A. obscuratus* by its bright metallic blue-green head and mesosoma; and from *A. viridulus* by the contiguous punctures on its mesoscutum. The female may be distinguished from other West Indian species, except *A. viridulus* and *A. swainsonae*, by its bright green head and mesosoma and black metasomal terga; from *A. viridulus* and *A. swainsonae* by the finer sculpturing of its interocular area.

### DESCRIPTION

#### MALE (Figs. 115-116, 148)

As in *A. viridulus* but with slightly finer and denser sculpturing; with slightly narrower apical groove on basal ridge of basitarsus; and with shallower and more numerous longitudinal grooves laterally on gonocoxa.

#### FEMALE (Figs. 37-38)

As in *A. viridulus* but bluer, smaller, and more finely sculptured, clypeal area not as elongate, and with narrower distal keel on labrum.

### *Agapostemon inca* n. sp.

This species is named for the Indians of the Quechuan tribe inhabiting Peru.

The male holotype and one male paratype are labeled, "Hda San Juan/Col Perene Peru/ 16 June 1920/ Cornell Univ. Exp./ Cornell Univ. Expedition Lot 607/ Sub 95." The above two specimens are in the collection of Cornell Univ., Ithaca, N.Y. The only other specimen I have seen is a

male (paratype) in the American Museum of Natural History labeled, "PERU: Montenegro/ Bagua, Amazonas/ Sept. 29-Oct. 2, 1963/ 350m. Wygodzinsky."

**DIAGNOSIS.** The male may be distinguished from those of most other species by the presence of a medial "button" at the base of its last visible (6th) sternum. This sternal "button" is much longer and broader than that of the closely related *A. mourei* (Figs. 139-140), and the hind femur, tibia and basitarsus are more slender than those of *A. mourei* (Figs. 167-168). *Agapostemon inca* may be distinguished from the related *A. intermedius*, *A. boliviensis* and *A. lanosus* by the larger and differently shaped medial plate of its gonostylus (Figs. 175, 177 A-B, 192).

**VARIATION.** The general appearance of the males differs strikingly because the black markings of the appendages and metasoma may be replaced by pale amber markings.

#### DESCRIPTION

##### MALE (Figs. 140, 168, 175, 218)

As in *A. mourei* but with head and mesosoma dark coppery green; antenna dark brown to black with yellow spot at base of lower side of scape; mesosoma with slightly finer punctures and less coarse rugae; tegula brown to brown-black, nearly obscuring anterior, submarginal, yellow crescent; fore leg yellow with coxa brown, trochanter brown but for anterior yellow spot, and brown on posterior of femur and tibia; middle leg brown with yellow spot on anterior of trochanter, yellow streak on anterior of femur, and small yellow spot anteriorly at either end of tibia; hind leg (Fig. 168) more slender, and dark brown with antero-dorsal yellow patch on femur; metasomal sterna brown with yellow on sterna 2-3; proximo-medial projection, or "button," on sternum 6 (Fig. 140) very broad, base with proximal portion wider than distal portion; genitalia (Figs. 175, 218).

##### *Agapostemon insularis* n. sp.

The name of this species refers to its island distribution.

I have seen four specimens (3 ♂, 1 ♀) from the island of Hispaniola. The female holotype and the allotype are labeled "Aux Cayes, Haiti/Mch. 15-20, '22/F. 4644." The two male paratypes are from Carrefour, Haiti (April) and the San Francisco Mts., Dominican Republic (Sept.). The types are in the American Museum of Natural History, New York.

**DIAGNOSIS.** The male may be distinguished from other West Indian species, except *A. jamaicensis* and *A. poeyi*, by its medial metallic tints on metasomal tergum 3; from *A. jamaicensis* and *A. poeyi* by its lack of posterolateral metallic tints on metasomal tergum 1. The female may be distinguished from other West Indian species, except *A. poeyi*, by its conspicuous

medial metallic green tints on metasomal sterna 3-4; and from *A. poeyi* by its finely punctate mesoscutellum.

## DESCRIPTION

## MALE

General coloration of head and mesosoma bright metallic green to blue-green, metasoma brown with yellow bands and tinted with green posteriorly. **Head:** as in *A. viequesensis*. **Mesosoma:** as in *A. viequesensis* but with sculpturing slightly finer, pronotum with lateral angle and posterior lobe both slightly more angular and with fewer postero-lateral carinulae, and tegula with metallic green tints slightly more extensive. **Metasoma:** (21) Terga as in *A. columbi* but with conspicuous metallic tints on tergum 3; pygidium rounded apically as in *A. viequesensis*. (22) *Sterna* as in *A. viequesensis*. (23) *Genitalia* as in *A. poeyi* but with apex of apical stylus on gonostylus slightly smaller (much closer to that of *A. poeyi* than that of *A. viequesensis*).

## FEMALE

General coloration of head, mesosoma and metasoma bright metallic greenish blue. **Head:** pubescence as in *A. viequesensis*. (1-4) *Labrum*, *clypeus*, *interocular area* and *vertex* as in *A. viequesensis*. (5) *Gena* much more coarsely carinate than that of *A. viequesensis* but not quite as coarse as in *A. poeyi*. (6) *Malar area* absent. (7-8) *Mandible* and *antenna* as in *A. poeyi*. **Mesosoma:** pubescence as in *A. viequesensis* but slightly more fuliginous on mesonotum and metanotum. (9) *Pronotum* as in *A. viequesensis* but with lateral angle and posterior lobe both more angular and with fewer and coarser (not as coarse as in *A. poeyi*) horizontal carinae postero-laterally. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. viequesensis*. (13-14) *Mesepisternum* and *metepisternum* as in *A. viequesensis* but with sculpturing very slightly coarser. (15) *Propodeum* as in *A. poeyi* but with finer sculpturing (not quite as fine as in *A. viequesensis*). (16-17) *Wing* and *tegula* as in *A. viequesensis* but tegula darker with metallic tints more extensive. (18-20) *Fore*, *middle* and *hind legs* dark brown, coxae with strong metallic tints. Pubescence dark amber to brown, scopal hairs white. **Metasoma:** as in *A. viequesensis* but with terga wholly metallic, and sterna 3-4 with strong metallic tints.

*Agapostemon intermedius* n. sp.

The name refers to the phenotype of this species which is intermediate between that of *A. semimelleus* and that of *A. heterurus*.

The male holotype, the allotype, and the 28 paratypes (4 ♂, 24 ♀) are all from Costa Rica: Gromaco, 34 km southeast of Potrero Grande, on the



Río Coto Brus, southern Puntarenas Province, 21 July 1963, 1,000 ft. (C. D. Michener and W. Kerfoot) and are in the Snow Entomological Museum at the University of Kansas.

**DISTRIBUTION.** In addition to the types I have seen specimens from the following localities: Turrialba (2 ♂, 8 July; 1 ♂, 31 July; 1 ♂, 1 Aug.; 1 ♂, 3 Aug.; 1 ♂, 10 Aug.; 1 ♂, 16 Aug.; 2 ♂, 28 Aug.; 1 ♀, 12 Sept.), 4.5 mi. SW Cartago (1 ♀, 3 July) and Pozo Azul at the confluence of Ríos Parrita and Candelaria (1 ♀, 9 Dec.), Costa Rica; 10 miles east of Cumaná, Venezuela (2 ♀, 13 March); Macas, Río Upano (1 ♂, 25 Jan.) and Pichilingue, Los Ríos (5 ♀, 2 Feb.), Ecuador; Monson Valley, Tingo Maria, Peru (1 ♂, 2 Nov.; 2 ♂, 21 Nov.; 3 ♂, 29 Nov.).

**DIAGNOSIS.** The male is easily distinguished from all other North and Central American *Agapostemon* by its medial "button" (flattened process resembling human tongue and attached to sternum in much the same way as human tongue is attached to floor of mouth) at the base of the last visible (6th) sternum (Fig. 136), and from the South American *Agapostemon* with similar "buttons" on sternum 6 by the low basal ridge and inconspicuous apical groove ventrally on its slender basitarsus (Fig. 151). The female may be distinguished from the other North and Central American species of *Agapostemon* by the basal yellowish bands on its metasomal terga 2-5 (may be obscured by overlapping terga posteriorly), and from South American species with yellow metasomal bands by its bright metallic green or coppery head and mesosoma and the unbroken yellow band on its clypeus (the yellow-banded South American females have only faint metallic tints and nearly always have the yellow clypeal band broken medially).

**VARIATION.** The coloration of females of this species varies considerably. While the female head and mesosoma are usually bright metallic green with amber and fuliginous pubescence, I have collected a female from Turrialba, Costa Rica, with bright coppery head and mesosoma and with fulvus pubescence. At first I was inclined to regard it as a separate species but the lack of morphological differences, and the slightly fulvus pubescence of the otherwise typical males from Turrialba, together with the similar pattern of variation in the sympatric *A. leunculus*, lead me to regard these differences as geographic variation.

The color of the yellow-banded metasomal terga of females varies from pale amber (Gromaco and Pozo Azul, Costa Rica; Cumaná, Venezuela; and Pichilingue, Ecuador) to brown-black (Turrialba, Costa Rica; Cumaná, Venezuela; and Pichilingue, Ecuador). Although it is difficult to assess such variation on the basis of so few specimens it appears that the color of the yellow-banded metasomal terga varies both within and among populations as does that of the North American *A. melliventris*.

## DESCRIPTION

MALE (Figs. 81-82, 136, 151, 192, 214)

General coloration of head and mesosoma bright metallic green, metasoma banded with black and yellow. **Head** (Figs. 81-82): with pubescence golden to fulvus on interocular area and vertex, becoming creamy on gena. (1) *Labrum* as in *A. texanus* but with apical portion much shorter and more acute at apex. (2) *Clypeus* with large, scattered, shallow punctures on lower (yellow)  $\frac{1}{2}$ - $\frac{2}{3}$ , becoming contiguous on upper (green)  $\frac{1}{3}$ - $\frac{1}{2}$ . (3) *Interocular area* with small to moderately small, deep, contiguous punctures below ocelli, becoming shallower and medium-sized at level of antennal sockets and still shallower below antennae; supraclypeal protuberance with large contiguous moderately deep punctures. Pubescence between antennal sockets  $\frac{1}{2}$ - $\frac{2}{3}$  as long as scape, becoming shorter laterally, dorsally and ventrally and subtomentose ventro-laterally. (4) *Vertex* with small, deep, contiguous punctures anteriorly and laterally, becoming shallower and slightly larger between ocelli and transversely carinate posteriorly. (5) *Gena* with parallel, subcontiguous, short (often very weak) carinae extending dorso-laterally from antero-ventral margin. Pubescence about as long as scape postero-medially, becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* yellow, very short, and with minute, appressed hairs. (7) *Mandible* yellow with apical  $\frac{1}{3}$  ferruginous to amber. (8) *Antenna* brown to brown-black above, scape yellow below, pedicel and flagellum yellowish to amber below. **Mesosoma**: pubescence creamy or yellowish becoming golden to fulvus on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe acutely pointed, lateral angle projecting antero-laterally; with conspicuous sharp carina extending postero-ventrally from apex of lateral angle; with weak irregular rugae postero-laterally. Pubescence above lateral angle and posterior lobe golden to fulvus, yellowish to creamy below. (10) *Mesoscutum* with large conspicuous flange laterally on anterior margin extending antero-dorsally; punctures small, very deep and contiguous, becoming rugose antero-laterally. (11) *Mesoscutellum* with medial punctures like those of mesoscutum, becoming slightly larger and less dense laterally; relatively shiny area with widely separated punctures on each side of midline. (12) *Metanotum* coarsely punctate to rugose medially, becoming moderately coarsely rugose laterally. (13) *Mesepisternum* moderately coarsely rugose anteriorly, becoming finely rugose posteriorly. (14) *Metepisternum* moderately finely rugose with horizontal rugae longer and slightly more prominent than other rugae, or with irregular horizontal carinae. (15) *Propodeum* with propodeal carina usually strong and conspicuous; propodeal shield very coarsely and deeply punctate to very coarsely rugose; dorsal area coarsely and very deeply rugose anteriorly and medially, becoming deeply and moderately rugose to coarsely punctate laterally; lateral area with small

and very deep subcontiguous punctures anteriorly and centrally, becoming coarsely rugose adjacent to propodeal carina. (16) *Wing* hyaline or nearly hyaline, veins dark brown. (17) *Tegula* pale to dark transparent amber with broad submarginal yellow band anteriorly (partially obscured by pubescence) and amber to dark brown on proximal margin. (18) *Fore leg* yellow with brown streaks posteriorly on femur and tibia. (19) *Middle leg* yellow with coxa brown and with brown postero-dorsally on tibia and postero-dorsally at apex of femur (also present posteriorly on trochanter of some specimens). (20) *Hind leg* (Fig. 151) yellow with upper  $\frac{1}{2}$  of coxa brown and tinted metallic green; with trochanter brown basally, becoming amber apically; with brown apically on femur and antero-dorsally on tibia.

**Metasoma:** (21) *Terga* 2-6 dark brown to brown-black on posterior  $\frac{1}{2}$  and yellow on anterior  $\frac{1}{2}$  (often partially concealed by overlap), tergum 1 dark brown to brown-black with broad yellow band antero-dorsally (centrally); very conspicuously punctate with subcontiguous punctures largest on tergum 1, becoming progressively smaller on posterior terga. Pubescence golden to fulvus anteriorly on tergum 1, laterally on terga 1-7 and dorsally on terga 5-7; very short dorsally on terga 1-4, golden to fulvus on yellow bands and dark brown to brown-black on dark bands. (22) *Sterna* yellow with brown on sternum 1 and with transverse bands on posterior margins of sterna 2-5 narrowest on sternum 2, becoming progressively wider (especially medially) posteriorly; sternum 6 with proximo-medial projection, or "button," in form of human tongue (Fig. 136); pubescence limited to scattered, moderately long, fulvus to golden hairs on exposed areas. (23) *Genitalia* (Figs. 192, 214) with ventral lobes very short and with a brush of large stiff hairs.

#### FEMALE (Figs. 47-48)

General coloration of head and mesosoma bright metallic green or coppery, metasoma pale amber to black and with yellow bands. **Head** (Figs. 47-48): pubescence golden to fulvus, becoming creamy to golden on gena. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with large scattered punctures on lower  $\frac{1}{2}$ , becoming subcontiguous on upper  $\frac{1}{2}$ . (3) *Interocular area* with small, moderately deep, contiguous punctures below ocelli, becoming rugose from just above antennal sockets to lower margin; supradypeal protuberance with medium sized punctures separated by nearly twice their diameters and with short, inconspicuous horizontal rugae. (4) *Vertex* with small, moderately deep, contiguous punctures anteriorly and laterally, becoming subcontiguous between ocelli and transversely carinate posteriorly. (5) *Gena* with fine, contiguous, parallel carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* amber, very short to absent. (7) *Mandible* yellow, becoming dark amber or ferruginous on apical  $\frac{1}{3}$ .

(8) *Antenna* dark brown to brown-black with underside of flagellum amber. **Mesosoma:** pubescence creamy to golden, becoming golden (with large scattered hairs dark) to fulvus (with large scattered hairs pale) on mesonotum and metanotum. (9) *Pronotum* as in ♂ but with weak carina extending from lateral angle to posterior lobe. (10) *Mesoscutum* as in ♂ but with most punctures slightly smaller and shallower (large scattered hairs in large punctures). (11) *Mesoscutellum* with sculpturing like that of mesoscutum but with small punctures slightly shallower. (12) *Metanotum* moderately finely rugose. (13) *Mesepisternum* as in ♂ but with sculpturing slightly more coarse. (14) *Metepisternum* horizontally carinulate with inter-connecting rugae. (15) *Propodeum* with strong propodeal carina; propodeal shield with conspicuous carinae extending dorso-laterally from medial groove and with fine rugae between conspicuous carinae; dorsal area coarsely and extremely deeply rugose anteriorly and medially, becoming moderately deeply and less coarsely rugose laterally; lateral area horizontally carinulate with small scattered punctures anteriorly becoming very coarsely and horizontally carinate posteriorly. (16) *Wing* as in ♂. (17) *Tegula* as in ♂ but slightly darker. (18) *Fore leg* with dark brown on coxa and trochanter; femur dark brown, becoming yellow anteriorly and dorsally on apical  $\frac{1}{3}$ ; tibia and tarsus yellowish to pale amber anteriorly, becoming brown posteriorly. Pubescence creamy on coxa, trochanter and femur; golden on tibia and tarsus. (19) *Middle leg* dark brown, becoming pale amber to yellowish anteriorly and dorsally on apical  $\frac{1}{4}$  of femur and at base of tibia; pubescence creamy on coxa and trochanter, becoming golden on femur, tibia and tarsus, and dark brown dorsally on tibia and tarsus. (20) *Hind leg* dark brown to pale brown with metallic green dorsally on coxa. Pubescence creamy on coxa, trochanter and femur; golden ventrally and dark brown to brown-black dorsally on tibia and tarsus. **Metasoma:** (21) *Terga* 2-5 pale amber to black, with yellow band on basal  $\frac{1}{3}$  of each (may be partially obscured by overlap); tergum 1 pale amber to black with inconspicuous pale spot dorso-laterally. Punctures small, separated by about  $\frac{1}{2}$  their diameters. Pubescence moderately short, amber to brown dorsally on terga 1-4 but with sparsely scattered longer and darker hairs increasing in size and abundance posteriorly from tergum 1; medium length, creamy to amber anteriorly on tergum 1 and laterally on terga 1-4; moderately long, dense and dark brown to black on terga 5-6. (22) *Sterna* dark brown on specimens with brown to brown-black on tergum 1, but sterna 1-3 and base of sternum 4 amber on specimens with tergum 1 amber; metallic tints basally on sternum 1. Long amber pubescence scattered on exposed areas.

*Agapostemon jamaicensis* n. sp.

This species is named for the island where it occurs.

I have seen a single male specimen labeled, "Moneage, Jamaica./Sept. 14,

1917 (497)/Harold Morrison." The holotype is in the United States National Museum, Washington, D.C.

**DIAGNOSIS.** The male may be distinguished from other West Indian species, except *A. poeyi* and *A. insularis*, by its posterior metasomal terga strongly tinted with metallic green medially and by its brown eyes and translucent amber to brown pterostigma; from *A. insularis* by its metallic green tints postero-laterally on metasomal tergum 1; and from *A. poeyi* by its more inflated hind femur and tibia.

#### DESCRIPTION

##### MALE (Fig. 146)

General coloration of head and mesosoma bright metallic blue-green, metasoma dark brown banded with yellow anteriorly, becoming bright metallic green posteriorly. **Head:** as in *A. viequesensis* but with sculpturing very slightly coarser and with pubescence pale amber. **Mesosoma:** pubescence as in *A. viequesensis*. (9) *Pronotum* as in *A. viequesensis* but with lateral angle and posterior lobe slightly more angular. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. viequesensis*. (13-14) *Mesepisternum* and *metepisternum* with sculpturing coarser than in *A. viequesensis* but not as coarse as in *A. poeyi*. (15) *Propodeum* as in *A. poeyi* females but with sculpturing slightly finer and antero-lateral area with large punctures replacing carinae. (16-19) *Wing*, *tegula*, *fore* and *middle legs* as in *A. viequesensis*. (20) *Hind leg* as in *A. viequesensis* but with femur and tibia more inflated, apical groove on basitarsus broader and convex centrally, and basal ridge more prominent with broad flat area on apical portion (Fig. 146). **Metasoma:** (21) *Terga* as in *A. viequesensis* but slightly darker and with bright metallic green replacing brown band completely on tergum 4 and partially on terga 1-3 and 5-6. (22) *Sterna* as in *A. viequesensis* but dark amber. (23) *Genitalia* as in *A. poeyi* but with apex of apical stylus of gonostylus more slender than that of *A. poeyi* (not as slender as *A. viequesensis*).

#### *Agapostemon kohliellus* (Vachal)

*Halictus (Agapostemon) kohliellus* Vachal 1903. Type ♀, Naturhistorisches Museum, Vienna.

I have examined the type of *H. kohliellus* and the locality label is illegible. This species is atypical of the genus inasmuch as the labrum of the female is trilobed (Fig. 31). For the present study it is included in *Agapostemon* because it is phenetically closer to this genus than to any other. Ultimately it may be desirable to erect a separate genus for this species.

**DISTRIBUTION.** Other than the type, I have seen specimens from Port au Prince (1 ♀, March) and Cul-de-Sac Plain (3 ♂, Dec.) Haiti and from Río Toa Baracoa, Cuba (1 ♂, April).



**DIAGNOSIS.** The male may be distinguished from all other West Indian species by its truncate clypeus, hind femur lacking tooth, and unique hind basitarsus. The females may be distinguished from all other West Indian species by the yellow band on the clypeus and by the yellow bands on the honey-colored metasoma.

#### DESCRIPTION

MALE (Figs. 109-110, 141, 191, 212)

General coloration of head and mesosoma metallic green, metasoma yellow with brown bands. **Head** (Figs. 109-110): pubescence white to yellowish on clypeus, interocular area and vertex; white on gena. (1) *Labrum* yellow, with apical margin transparent; apex truncate to very slightly bilobed, basal  $\frac{1}{2}$  without medial depression on transverse basal ridge; labral surface shiny and impunctate with row of small, simple submarginal setae. (2) *Clypeus* yellow with metallic green on upper margin, truncate, but not nearly as much as in *A. nasutus* (Figs. 85-87); flattened lower portion with several small shallow punctures and nearly glabrous, narrow upper portion with shallow scattered punctures and with short sparse pubescence. (3) *Interocular area* with deep, coarse, contiguous punctures above; deeply rugulose around antennal sockets, becoming less deeply rugulose below. Supraclypeal protuberance small but relatively acute, shallowly and coarsely rugose below, weakly rugulose above. Pubescence between antennal sockets about  $\frac{2}{3}$  as long as scape, becoming slightly shorter dorsally, laterally and ventrally; becoming short appressed tomentum ventro-laterally. (4) *Vertex* with deep, contiguous, medium-sized punctures anteriorly, laterally and between ocelli; becoming rugose posteriorly. Pubescence like that of dorsal portion of interocular area. (5) *Gena* with weak rugae extending postero-dorsally from antero-ventral margin; postero-medial pubescence slightly longer than that between antennal sockets, becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* absent. (7) *Mandible* yellow, ferruginous on apical  $\frac{1}{3}$ . Row of hairs on postero-ventral margin only  $\frac{1}{3}$  as long distally as proximally. (8) *Antenna* brown above, but scape with yellow on basal  $\frac{1}{2}$  of upper surface; scape and pedicel yellow below, flagellum amber below. **Mesosoma:** pubescence white, yellowish on mesonotum and metanotum. (9) *Propodeum* with lateral angle and posterior lobe rounded; sculpturing weak and inconspicuous. (10) *Mesoscutum* with deep, small, contiguous punctures becoming rugose antero-laterally. (11) *Mesoscutellum* with small, deep punctures separated by at least their diameters, becoming rugose laterally. (12) *Metanotum* shallowly rugose with small, deep punctures more abundant than those of mesoscutellum. (13) *Mesepisternum* finely rugulose anteriorly, becoming very finely rugulose posteriorly. (14) *Metepisternum* horizontally carinulate. (15) *Propodeum* rounded posteriorly

with propodeal carina absent; small, deep punctures laterally separated by at least their own diameters, becoming rugulose or contiguously punctate postero-dorsally; propodeal shield shallowly rugulose. (16) *Wing* transparent; veins and pterostigma dark brown, radius almost black. (17) *Tegula* pale transparent honey-colored with yellow on basal margin and with yellow band almost reaching distal margin. (18-19) *Fore* and *middle legs* yellow with coxae metallic green. (20) *Hind leg* (Fig. 141) yellow with trochanter brownish, brown apically on dorsal surface of femur and amber on all but ventral surface of tibia, and with coxa metallic green; femur without tooth; femur and tibia moderately inflated; basitarsus broad but flat with basal ridge narrow and gently curved apically; basitarsus lacking apical groove. **Metasoma:** (21) *Terga*. Tergum 1 yellow, amber anteriorly and brown apically; terga 2-6 with basal yellow band and apical brown band of equal width; tergum 7 amber. Pubescence minute and inconspicuous dorsally, amber on yellow bands, and black on brown bands; long brown hairs dorsally on terga 5-7; long pale hairs ventro-laterally on terga 4-6 and anteriorly on tergum 1. (22) *Sterna* amber with white hairs on exposed areas. (23) *Genitalia* (Figs. 191, 212), ventral lobe short with long brush of hairs on short inner portion.

## FEMALE (Figs. 31-32)

General coloration of head and mesosoma bright metallic green, metasoma honey-colored with yellow bands. **Head** (Figs. 31-32): with short white pubescence. (1) *Labrum* (Figs. 31A-B) with acute lateral lobes on apical  $\frac{1}{2}$ . (2) *Clypeus* yellow below, green above; yellow portion shiny, sparsely punctate, green portion with medium-sized deep, contiguous punctures. (3) *Interocular area* rugulose, becoming finely and deeply punctate above; supraclypeal protuberance low and gently rounded with medium-sized punctures separated by their own diameters and with numerous horizontal rugae; pubescence between antennal sockets only about  $\frac{1}{3}$  as long as scape. (4) *Vertex* with fine, deep, contiguous punctures anteriorly, becoming smaller, shallower and subcontiguous laterally and faintly rugulose posteriorly; area between ocelli shiny with small scattered punctures. (5) *Gena* with fine, contiguous rugulae extending postero-dorsally from antero-ventral margin; pubescence postero-medially about  $1.5 \times$  as long as pubescence between antennal sockets and becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* absent. (7) *Mandible* yellow with apical  $\frac{1}{3}$  ferruginous; single row of hairs on postero-ventral margin long basally, becoming  $\frac{1}{3}$  as long distally. (8) *Antenna* brown, flagellum yellowish to amber below. **Mesosoma:** short white to yellowish pubescence. (9) *Pronotum* with lateral angle and posterior lobe rounded; sculpturing very fine, weak and irregularly rugulose ventro-laterally, becoming smooth dorso-

medially. (10) *Mesoscutum* with small contiguous punctures, becoming faintly rugulose antero-laterally. (11) *Mesoscutellum* shiny, with scattered large punctures and more numerous very small punctures. (12) *Metanotum* sparsely punctate, irregularly and transversely rugulose. (13) *Mesepisternum* with shallow, fine rugae anteriorly, becoming much finer and transversely rugulose to carinulate posteriorly. (14) *Metepisternum* with shallow, regular transverse carinulae. (15) *Propodeum* with distinct but weak propodeal carina; very fine, regular, horizontal carinulae laterally and on propodeal shield; dorsal area with very fine carinulae extending postero-laterally from anterior margin. (16-17) *Wing* and *tegula* as in  $\delta$ . (18-20) *Fore, middle* and *hind legs* yellowish to amber with white to yellowish pubescence becoming fuliginous dorsally on middle and hind tibiae. **Metasoma:** (21) *Terga* amber to pale brown with yellow bands basally on terga 2-5; tergum 1 may have pale yellow band anteriorly on dorsal portion interrupted medially; pubescence as in  $\delta$ . (22) *Sterna* amber to brown with long white hairs scattered on exposed areas.

#### **Agapostemon lanosus** n. sp.

The name of the species refers to the woolly appearance of the mesoscutal pubescence.

The male holotype and the allotype are labeled, "PERU:/ Monson Valley/ Tingo Maria/ XI-21-1954// E. I. Schlinger/ &E. S. Ross collectors." The two male paratypes were collected by Ross and Schlinger from the same locality on "29-XI-1954" and "XII-23-1954." At present, these types are the only known specimens and they are in the California Academy of Sciences, San Francisco.

**DIAGNOSIS.** The male may be distinguished from most other species by the presence of a medial "button" at the base of its last visible (6th) sternum (Fig. 138). It may be distinguished from other species with sternal "buttons" by the presence of 2-3 long (about twice the length of adjacent setae), thickened, apically hooked setae laterally on the posterior margin of the antepenultimate visible (4th) sternum.

The female may be distinguished from most other species by the acute lateral angle and posterior lobe of its pronotum and by the dense woolly pubescence of its mesoscutum; from *A. mourei* and *A. boliviensis* by the lack of yellow on its clypeus, by its less finely branched mesoscutal pubescence and by its coarser genal sculpturing; from *A. heterurus* by the parallel striae dorsally on its pronotum and by the coppery luster of its head and mesosoma.

**VARIATION.** The general appearance of the males varies strikingly because the black markings of the appendages and metasoma may be replaced by pale amber markings.

## DESCRIPTION

## MALE (Figs. 138, 169, 177B, 216)

As in *A. mourei* but with head and mesosoma bright coppery green; antenna dark brown to black with scape yellow below; mesoscutellum with punctures widely scattered in central region; tegula darker amber with anterior, submarginal, yellow crescent partially obscured proximally; fore leg yellow with brown on posterior of coxa, trochanter, femur and tibia and anteriorly at base of coxa; hind basitarsus (Fig. 169) yellow with dark brown to black on ventral carina; metasomal sterna dark brown with yellow on sterna 2-3; sternum 6 (Fig. 138) with proximo-medial projection, or "button," with each lateral flange slightly less than  $\frac{1}{2}$  width of base (as measured on transverse section through widest part of "button"); genitalia (Figs. 177B, 216).

## FEMALE

As in *A. mourei* but clypeus without yellow band; gena with deeper striae; meso- and metanotum with pubescence darker and slightly less woolly; propodeum dorsally with coarse, deep striae extending postero-laterally from anterior margin; metasoma dark brown with yellowish amber on tergum 1 and proximo-laterally on terga 2-5.

**Agapostemon leunculus** Vachal

*Agapostemon leunculus* Vachal 1903. Lectotype ♀, Muséum National D'Histoire Naturelle, Paris.

*Agapostemon vulpicolor* Crawford 1906 (new synonymy). Type ♀, U.S. National Museum.

*Agapostemon nasutus* var. *ater* Friese 1916 (new synonymy). Type ♀, whereabouts unknown.

From the 30 syntypes of *Agapostemon leunculus* in the Paris Museum, I have designated a female as lectoholotype. I have seen the type of *A. vulpicolor* but not that of *A. nasutus ater*. As noted by Michener (1954), *A. nasutus ater* is not conspecific with *A. nasutus*. I have seen a female "Typus" (not a type, but identified by Friese) of *A. nasutus ater* from the U.S. National Museum labeled, "Costa Rica./San José,/1903." Friese did not describe the male, probably because he was expecting to find something with the "hog-nosed" aspect of *A. nasutus*. The only difference between *A. leunculus* and *A. nasutus ater* is the coloration of the pubescence and integument of the head and the dorsal surface of the thorax. I have not found any differences among the males that can be correlated with the variation among females. Because I have seen females intermediate in coloration (see discussion of variation) I am considering the difference between *A. leunculus* and *A. nasutus ater* as local variation.

DISTRIBUTION. *Agapostemon leunculus* is found in Mexico exclusive of the central plateau, as far north along the eastern coast as ten miles southwest of Pharr, Texas (1 ♀ collected by C. D. Michener) and as far north

along the western coast as Rosario, Sinaloa. It has been collected in the mountainous regions of southern Mexico but has not been taken on the Yucatan Peninsula. It has also been collected in the mountains of El Salvador, Honduras, Costa Rica, Panama, Colombia and Ecuador (Fig. 5).

Although information on altitudinal distribution is scant, this species has not been found at low altitudes (less than 1,000 m) in the hot tropics. It has been collected from 32 m (105 ft.) at Rosario, Sinaloa, Mexico, up to 7,100 ft. (2,164 m) near Nochixtlán, Oaxaca, Mexico; from 3,300 ft. (1,006 m) at Santiago de Puriscal, Costa Rica, up to 9,000 ft. (2,743 m) on Volcan Irazú, Costa Rica; 7,800 ft. (2,377 m) at Popayan, Colombia, and 2,800 m (9,184 ft.) at Calacali, Ecuador. *A. leunculus* has been collected in February and October in Ecuador; February in Colombia; every month but January, March, June and November in Central America; every month but January and November in Mexico; and on March 31 near Pharr, Texas. Undoubtedly this bee is more widely distributed altitudinally and seasonally than is indicated by these records. I have seen fewer than 300 specimens, and this sample is probably biased because bee collectors seldom work as high as 3,000 m and because most of the specimens were collected by North Americans, who seldom have an opportunity to collect from October through May.

**DIAGNOSIS.** The male may be differentiated from males of many other species by its slender, untoothed hind femora and rounded lateral pronotal angle; from *A. nasutus* by its normal clypeal region; from *A. rhopalocera* by its normal antennae; from *A. peninsularis* and *A. mexicanus* by its lack of enlarged subapical hairs on metasomal sternum 4; and from *A. melliventris* by the black on the basal portion of its metasomal tergum 1. The female may be distinguished from other species with black metasoma and green or coppery head and mesosoma by the prominent carina extending postero-ventrally from the rounded lateral angle of its pronotum.

**VARIATION.** The coloration of the head and dorsal mesosomal region, as well as the pubescence thereon, is quite variable in females of this species. Most of the females are metallic green on the head and thorax. Some of the females from Costa Rica (Volcan Irazú, San José, Cartago and San Mateo) have reddish or coppery integument on the head and the dorsal mesosomal area. The pubescence on these areas is orange. Although nowhere else so extreme, I have seen females from Mexico (e.g., Orizaba, Vera Cruz; Ajijic, Jalisco; Tehuacan, Puebla; and near Oaxaca, Oaxaca) with orange pubescence and with coppery tints on the head and the dorsal mesosomal area. In still other areas (e.g., near Ciudad del Maiz and San Luis Potosí) the integument is green but the pubescence orange. In those regions where the orange of the pubescence and the coppery color is most pronounced, the yellow band on the clypeus of females is often reduced or absent. As these regions are relatively cool and wet, it is not surprising that the females are



more darkly pigmented. The pigmentation of the males is correlated with that of the females. Those males with enlarged black or brown markings are found with the darker females. As in the females, intergrades may be found between the lightest and darkest males. It is the presence of color intergrades and the lack of structural differences that lead me to synonymize *A. leunculus* and *A. nasutus ater*. Some of the females from Costa Rica, Colombia and Ecuador have fuliginous pubescence on the head and dorsal mesosomal regions, but sympatric intermediates exist for this condition also. The tegulae of those females with orange or fuliginous pubescence are often dark brown to black, unlike the more common yellow and transparent tegulae of females from warmer, drier areas.

#### DESCRIPTION

##### MALE (Figs. 83-84, 143, 193, 211)

General coloration of head and mesosoma metallic green, metasoma with black and yellow bands. **Head** (Figs. 83-84): (1) *Labrum* as in *A. texanus* but more acute apically. (2) *Clypeus* with small scattered punctures on yellow portion, larger and deeper scattered punctures on green portion; scattered yellowish hairs directed ventrally. (3) *Interocular area* with punctures above antennal sockets contiguous, deep and nearly rugose; coarsely and shallowly punctate at level of antennal sockets becoming coarsely, shallowly and irregularly rugose below; supraclypeal protuberance with coarse, contiguous punctures; pubescence pale amber. (4) *Vertex* with fine, contiguous punctures becoming coarse posteriorly; pubescence pale amber. (5) *Gena* with sparse, shallow carinae extending postero-dorsally from antero-ventral margin; pubescence dense, white, longest posteriorly. (6-7) *Malar area* and *mandible* as in *A. texanus*. (8) *Antenna* dark brown to black above except basal  $\frac{1}{2}$  of scape; yellow to amber below, basal  $\frac{1}{2}$  of scape usually yellow. **Mesosoma**: pubescence moderately long, evenly distributed (except pronotum), and whitish to amber. (9) *Pronotum* with weak carina running postero-ventrally from lateral angle; condition of lateral angle and posterior lobe intermediate between *A. nasutus* and *A. texanus*. Pubescence above and between lateral angle and posterior lobe similar to that of mesoscutum; short, white, appressed, inconspicuous pubescence on postero-ventral surface. (10) *Mesoscutum* with punctuation as in *A. nasutus* but slightly finer and with rugosity restricted to antero-lateral portions. (11) *Mesoscutellum* with punctures slightly deeper and larger than those of mesoscutum. (12) *Metanotum* coarsely punctate medially to shallowly rugose laterally. (13) *Mesepisternum* with punctuation as in *A. nasutus*. (14) *Metepisternum* with predominately horizontal, irregularly anastomosing rugae not as regular as in *A. nasutus*. (15) *Propodeum* coarsely punctate antero-laterally becoming moderately rugose postero-laterally and

very coarsely rugose dorsally; propodeal carina weak, evenly rounded dorsally, sometimes obscured by coarse rugae; propodeal shield very coarsely and irregularly rugose. (16) *Wing* transparent, not darkened apically, radius scarcely darker than other veins. (17) *Tegula* as in *A. nasutus* but transparent brown proximally and with less yellow. (18) *Fore leg* yellow, often with postero-dorsal black streak on any or all segments but tarsus; pubescence as in *A. nasutus* but yellow to amber on tibia and tarsus. (19) *Middle leg* yellow with coxa brown to black, postero-dorsal brown streak on proximal  $\frac{1}{2}$  of tibia, and commonly with brown streak on part or entire length of postero-dorsal surface; pubescence like that of fore leg but shorter on coxa, trochanter and femur. (20) *Hind leg* (Fig. 143) coxa metallic green and usually with some yellow on ventral surface; trochanter predominately yellow, brownish dorsally to wholly brown or black; femur with brown dorsally and posteriorly at apex; proximal  $\frac{1}{2}$  of tibia with brown streak on dorsal  $\frac{1}{2}$  sometimes extending to apex; tarsus yellow to brown; pubescence as in *A. nasutus* but slightly shorter and darker. **Metasoma:** (21) *Terga* shiny; 2-6 with yellow on basal  $\frac{1}{2}$ , apical  $\frac{2}{3}$  black; tergum 1 black with yellow band on antero-dorsal surface; tergum 7 yellow basally, pygidial region brown to black; pubescence sparse, simple, moderately long, and white on vertical portion of tergum 1; terga 2-4 with short simple hairs, white on yellow bands and black on dark bands; terga 5-7 with moderately long, stiff, simple, black hairs. (22) *Sterna* 2-5 yellow with brown bands subapically; sternum 1 green basally, apical  $\frac{1}{2}$  yellow with amber medial stripe; pubescence white, short and simple. (23) *Genitalia* (Figs. 193, 211) very simple; penis valves broad and without conspicuous prominences; gonostylus elongate with short curved apical stylus and long medial plate of moderate width; ventral lobes notched as in *A. nasutus* but smaller and with smaller notches.

#### FEMALE (Figs. 45-46, 135)

General coloration of head and mesosoma dark metallic green to blue-green, metasoma shiny black with narrow, inconspicuous basal bands of white tomentum. **Head** (Figs. 45-46): (1-4) *Labrum*, *clypeus*, *interocular area* and *vertex* as in *A. nasutus* but with slightly coarser sculpturing and with pubescence white to yellow or fuliginous. (5) *Gena* with deep, coarse, parallel carinae running postero-dorsally from antero-ventral margin irregularly anastomosing on some specimens; pubescence white (never yellow) and shorter than in *A. nasutus*. (6) *Malar area* ferruginous, very short. (7) *Mandible* as in *A. nasutus*. (8) *Antenna* black above, dark brown below, undersides of first two flagellomeres often lighter than others. **Mesosoma:** metallic green, never with yellow spot on posterior lobe of pronotum, as in *A. nasutus*. (9) *Pronotum* (Fig. 135) as in *A. nasutus* but with

prominent carina running postero-ventrally from lateral angle. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* with punctuation as in *A. nasutus* but slightly finer and without shiny lateral area on mesoscutellum; pubescence more dense than in *A. nasutus* and white to orange or fuliginous. (13) *Mesepisternum* very coarsely rugose anteriorly to moderately rugose posteriorly; white to yellowish pubescence. (14) *Metepisternum* with moderately coarse horizontal carinae anteriorly, becoming rugose posteriorly; pubescence creamy. (15) *Propodeum* coarsely rugose dorsally and postero-laterally, becoming finely rugose antero-laterally; propodeal carina prominent, strongly curved dorsally and laterally; propodeal shield with irregularly anastomosing carinulae extending laterally from mid-line. (16) *Wing* as in ♂. (17) *Tegula* as in ♂ but may also be brown to black. (18) *Fore leg* dark brown, usually with some yellow on antero-apical portion of femur and antero-basal portion of tibia; pubescence yellowish brown ventrally, brown to black dorsally. (19-20) *Middle* and *hind legs* dark brown, with pubescence brown ventrally and black dorsally. **Metasoma:** (21) *Terga* black, shinier than in *A. nasutus*. Narrow basal bands of white tomentum on terga 2-5; long, pale hairs scattered on vertical portion of tergum 1 and lateral margins of terga 2-5; long black hairs on apical half of terga 4-5. (22) *Sterna* black with long pale hairs on exposed areas.

### Agapostemon melliventris Cresson

*Agapostemon melliventris* Cresson 1874 (not 1875). Type ♀, Academy of Natural Sciences, Philadelphia.

*Agapostemon fasciatus* Crawford 1901 (new synonymy). Type ♀, U.S. National Museum.

*Halictus (Agapostemon) plurifasciatus* Vachal 1903 (new synonymy).

*Agapostemon digueti* Cockerell 1924. Type ♀, California Academy of Sciences, San Francisco.

Cresson described this species as new in two different publications (1874, 1875). Obviously the earlier publication is valid and the latter superfluous.

I have seen the types of *Agapostemon melliventris*, *A. fasciatus* and *A. digueti* and believe they are conspecific. *Agapostemon fasciatus* Crawford has been considered by most authors to be of subspecific rank because it differs from *A. melliventris sensu stricto* in having females with black metasomal terga. I have accorded it neither subspecific status, because in many areas (cf. Arizona, Fig. 6) it is sympatric with *A. melliventris s.s.*, nor specific status because intermediate forms are too common (cf. discussion of variation).

When Vachal placed *Agapostemon* in the genus *Halictus*, *Agapostemon fasciatus* became a junior secondary homonym of *Halictus fasciatus* Nylander. Thus Vachal renamed the former *Halictus (Agapostemon) plurifasciatus*. Few workers agreed with Vachal's placement of *Agapostemon* as a subgenus of *Halictus*. If other workers wish to apply a name to this dark color form they should use the epithet proposed by Vachal. Cockerell

(1937a) and Michener (*In* Muesebeck, et al., 1951) believed Crawford's epithet should be used, but according to the International Code of Zoological Nomenclature (anonymous, 1964) secondary homonyms rejected before 1961 cannot be revived (cf. *Agapostemon coloradinus*).

**DIAGNOSIS.** The male may be distinguished from other species of *Agapostemon* by its yellow metasomal terga with brown to brown-black restricted to narrow subapical bands. The female may be distinguished from other North American species (except *A. nasutus*, *A. leunculus* and *A. peninsularis*) by the yellow band on the lower margin of its clypeus; from *A. nasutus* by the lack of a yellow spot on the posterior lobe of its pronotum; from *A. leunculus* by its lack of a prominent carina extending postero-ventrally from the lateral angle of the pronotum; and from *A. peninsularis* by its coarser propodeal sculpturing and less dense pubescence. In most females of *A. melliventris* the metasomal terga are pale amber, unlike the black metasomal terga of *A. peninsularis* (and some specimens of *A. melliventris*).

**VARIATION.** The most striking variation is the color of the metasoma of females (see map, Fig. 6). In females from the central plains of Oklahoma, Kansas, Nebraska and South Dakota, the metasoma is almost always black. From the opposite side of the range, in females from Baja California and Sonora, it is more commonly black than amber. In the remaining portion of the range the female metasoma is usually amber, but a few females with the metasoma black or dark brown may be found in these regions. I have seen specimens intermediate with respect to color of abdomen in all areas, but they are rare in the central plains. The amount of yellow on the clypeus and scape is positively correlated with the paleness of the metasoma, those specimens from the central plains having a narrow band of yellow on the clypeus and little or no yellow on the scape.

There is no variation in the color or color pattern of males corresponding to that of females. The size and darkness of the brown regions on the metasoma, legs and antennae varies slightly within, but not among, populations.

One of the most obvious variables in the phenotype is size. As shown in Figures 93-94, the linear dimensions of larger specimens may be nearly twice those of smaller specimens collected at the same time and place. This size variation is somewhat greater among males than among females and does not appear to be influenced by geographic factors.

#### DESCRIPTION

MALE (Figs. 92-94, 155, 188, 203)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma yellow with narrow brown bands; all pubescence white.

**Head** (Figs. 92-94): (1) *Labrum* as in *A. texanus* but with transparent distal margin slightly wider. (2) *Clypeus* with medium-sized punctures separated by about their diameters below, nearly contiguous above. (3) *Interocular area* with medium-sized, moderately deep, contiguous punctures becoming minute, shallow and sub-contiguous ventro-laterally. (4) *Vertex* with medium-sized, moderately deep, contiguous punctures anteriorly, becoming slightly smaller and shallower laterally, and rugulose posteriorly and between ocelli. (5) *Gena* with very weak, short, parallel carinulae extending postero-dorsally from antero-ventral margin. (6) *Malar area* yellow; short. (7) *Mandible* yellow with distal third ferruginous to amber. (8) *Antenna* with scape yellow (small brown spot apically on upper side on some specimens); pedicel dark brown above, yellow below; flagellum dark brown above (yellow at apex of last flagellomere) and yellow to pale amber below. **Mesosoma**: (9) *Pronotum* with lateral angle and posterior lobe rounded; low rounded vertical ridge below lateral angle and faint, parallel, horizontal carinae below posterior lobe. (10) *Mesoscutum* with moderately fine, moderately deep, contiguous punctures becoming rugose antero-laterally. (11) *Mesoscutellum* with punctures like those of mesoscutum but slightly less dense and sometimes subcontiguous laterally. (12-13) *Metanotum* and *mesepesternum* moderately finely rugose. (14) *Metepisternum* with sculpturing as in mesepesternum but slightly coarser and horizontal. (15) *Propodeum* with propodeal carina moderately weak; propodeal shield coarsely but shallowly rugose; dorsal area coarsely and moderately deeply rugose; lateral area with moderately coarse rugae postero-dorsally, becoming moderately finely rugose antero-ventrally. (16) *Wing* hyaline; radial vein brown, other veins and pterostigma pale amber. (17) *Tegula* colorless and transparent with opaque yellow band submarginal anteriorly, marginal basally and posteriorly. (18-19) *Fore* and *middle legs* yellow with coxae bright metallic green. (20) *Hind leg* (Fig. 155) like fore and middle legs but with brown spot distally on dorsal surface of femur and basally on dorsal surface of tibia; femur without tooth and basitarsus without apical groove or basal ridge. **Metasoma**: (21) *Terga* yellow with narrow, subapical, brown bands and with apical  $\frac{1}{4}$ - $\frac{1}{3}$  transparent, pale amber; tergum 1 with anterior surface very pale amber to yellow; tergum 7 with pygidium pale amber. Short appressed pubescence dorsally becoming moderately long anteriorly, posteriorly and laterally. (22) *Sterna* yellow with faint metallic tints basally on sternum 1; narrow brown bands subapically on sterna 2-4; broad brown band subapically on sternum 5; and sternum 6 largely brown, with pale amber to yellow disto-laterally; moderately short to moderately long scattered hairs on exposed areas. (23) *Genitalia* (Figs. 188, 203) with medium-sized and slightly elongate ventral lobe on gonocoxite fringed with hairs and with short hairs rather dense on posterior surface.



## FEMALE (Figs. 61-62)

General coloration of head and mesosoma bright metallic green to blue-green; metasoma pale amber to black and with broad bands of white tomentum. **Head** (Figs. 61-62): pubescence white, rarely tinged faintly with pale yellow on vertex. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with moderately small, scattered punctures below, becoming subcontiguous to contiguous above. (3) *Interocular area* rugose below, becoming rugulose to coarsely punctate above; supraclypeal area shallowly punctate to weakly rugose. (4) *Vertex* contiguously and coarsely punctate to rugulose anteriorly, becoming contiguously and less coarsely punctate laterally; area behind and between ocelli weakly rugulose. (5) *Gena* with numerous moderately fine, contiguous carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* amber; very short. (7) *Mandible* yellow with apical  $\frac{1}{2}$  ferruginous. (8) *Antenna* with scape sometimes black, but usually yellow with brown or black on apical  $\frac{1}{2}$  of upper surface; pedicel brown below, brown-black above; flagellum brown to brown-black above, pale amber to brown below. **Mesosoma**: pubescence white, rarely tinged faintly with very pale yellow on mesoscutum. (9) *Pronotum* as in  $\delta$ . (10) *Mesoscutum* with medium-sized, moderately deep, contiguous punctures, becoming finely rugose anteriorly and moderately rugose antero-laterally. (11) *Mesoscutellum* with punctures like those of mesoscutum but sometimes less dense and subcontiguous laterally. (12) *Metanotum* moderately finely and shallowly rugose. (13) *Mesepisternum* moderately coarsely and deeply rugose. (14) *Metepisternum* rugose (like mesepisternum) to horizontally carinate with carinae anastomosing most often near posterior margin. (15) *Propodeum* with strong propodeal carina; propodeal shield very faintly rugose; dorsal area moderately to coarsely rugose; lateral area with shallow, horizontal, anastomosing rugae, very fine to moderately fine anteriorly, becoming much coarser and slightly deeper posteriorly. (16) *Wing* as in  $\delta$ . (17) *Tegula* as in  $\delta$  but with metallic green tints on proximal margin. (18) *Fore leg* with coxa brown to brown-black, tinged with metallic green; trochanter sometimes black, but usually pale amber with yellow on distal  $\frac{1}{2}$  of anterior surface; femur entirely yellow to brown-black with small yellow spot dorsally at apex; tibia yellow to brown with yellow antero-dorsally on basal  $\frac{4}{5}$ ; and tarsus yellow to brown. Pubescence white to amber. (19) *Middle leg* like fore leg but dark specimens with faint metallic tints on trochanter and with yellow area on tibia reduced to small spot dorsally at base; pubescence like that of fore leg but faintly fuliginous on darker specimens. (20) *Hind leg* with coxa bright metallic green dorsally and brown, strongly tinged with metallic green elsewhere; trochanter brown to brown-black; femur, tibia and tarsus pale amber to brown-black. Pubescence white to pale amber, becoming fuliginous basally on dorsal area of tibia of darker specimens.

**Metasoma:** (21) *Terga* pale amber with small black spots laterally on terga 3-4 to entirely black with distal margins transparent (see preceding discussion of variation). Pubescence white, becoming pale amber around pygidium; bands of dense tomentum on basal halves of terga 2-5, and centrally on tergum 1 (often interrupted medially on tergum 1); short, appressed, inconspicuous hairs distal to bands of tomentum; moderately long hairs anteriorly on tergum 1, ventro-laterally on terga 1-5, and dorsally on terga 5-6. (22) *Sterna* pale amber to black with scattered, long, white hairs on exposed areas.

### *Agapostemon mexicanus* n. sp.

The name of this species refers to the country where it is found.

The male holotype and the three male paratypes are labeled, "14 mi. S./El Arco Mine/L. Cal. VI-23-38//Michelbacher & Ross Collectors." The allotype is labeled, "Mesquital/L. Cal. VII-28-38//Michelbacher & Ross Collectors." All of these types are in the California Academy of Sciences, San Francisco.

**DISTRIBUTION.** In addition to the localities listed above I have seen specimens from: Santa Maria Valley (3 ♂, 11 Aug.), Magdalena Bay (1 ♂, 30 May), and 28 miles south of El Arco, Baja California, Mexico (1 ♀, 3 July); 25 miles south of Navajoa, Sonora, Mexico (1 ♀, 13 Sept.); 17 miles south of Navajoa, Sonora, Mexico (1 ♂, 18 Aug.).

**DIAGNOSIS.** The male may be distinguished from all other North American species of *Agapostemon* by the comb of 14-20 large, evenly spaced submarginal bristles on metasomal sternum 4. The female may be distinguished from *A. splendens*, *A. texanus*, *A. angelicus*, *A. jemoratus*, *A. cockerelli* and *A. aenigma* by its black metasoma; from *A. melliventris*, *A. peninsularis*, *A. nasutus*, *A. leunculus* and *A. intermedius* by the absence of yellow on its clypeus; from *A. erebus* and *A. atrocaeruleus* by the bright metallic green to blue-green of its head and mesosoma; and from *A. tyleri* by the lack of a smooth shiny area (with scattered punctures) centrally on its supraclypeal protuberance.

### DESCRIPTION

MALE (Figs. 90-91, 156, 189, 204)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma banded with black and yellow. **Head** (Figs. 90-91): pubescence white, becoming yellowish on interocular area and vertex. (1) *Labrum* as in *A. texanus* but slightly more obtuse apically. (2) *Clypeus* as in *A. melliventris* but with medial enlargement of yellow band not quite as prominent. (3-7) *Interocular area*, *vertex*, *gena*, *malar area* and *mandible* as in *A. melliventris*. (8) *Antenna* brown-black with scape and pedicel

yellow below, flagellum pale amber below. **Mesosoma:** pubescence white, becoming yellowish on mesonotum and metanotum. (9-12) *Pronotum*, *mesoscutum*, *mesoscutellum* and *metanotum* as in *A. melliventris*. (13) *Mesepisternum* more coarsely rugose than metanotum (especially anteriorly). (14-15) *Metepisternum* and *propodeum* as in *A. melliventris* but with finer sculpturing. (16) *Wing* as in *A. melliventris* but veins darker brown. (17) *Tegula* as in *A. melliventris* but with metallic green tints basally and with transparent areas very pale amber. (18-20) *Fore*, *middle* and *hind legs* as in *A. peninsularis* but with brown-black streak on tibiae posterior (Fig. 156). **Metasoma:** (21) *Terga* as in *A. peninsularis* but with pubescence shorter and less dense. (22) *Sterna* 2-4 yellow with brown submarginal band posteriorly, sterna 5-6 brown, sternum 1 with metallic green tints basally; pubescence long and pale on brown areas; sternum 4 with low submarginal ridge posteriorly and row of 14-20 large, evenly spaced bristles just distal to submarginal ridge. (23) *Genitalia* (Figs. 189, 204) with medium-sized ventral lobe on gonocoxite fringed with hairs.

#### FEMALE (Figs. 63-64)

General coloration of head and mesosoma bright metallic green, metasoma black. **Head** (Figs. 63-64): as in *A. melliventris* but lower margin of clypeus black instead of yellow and with pubescence becoming slightly fuliginous at vertex. **Mesosoma:** pubescence white, becoming fuliginous on mesonotum and metanotum. (9-15) *Pronotum*, *mesoscutum*, *mesoscutellum*, *metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. melliventris* but with finer sculpturing. (16) *Wing* hyaline with veins brown, radius much darker than other veins. (17) *Tegula* as in *A. melliventris*. (18) *Fore leg* brown-black with faint metallic green on coxa and with yellow to pale amber anteriorly and dorsally on tibia and apically on femur. (19-20) *Middle* and *hind legs* brown to brown-black with hind coxa metallic green dorsally and tinged with metallic green anteriorly. Pubescence dark brown dorsally on tibiae. **Metasoma:** (21) *Terga* brown-black to black. Pubescence white becoming brown-black around pygidium; moderately long, becoming short and appressed dorsally; dense tomentum on basal third of terga 2-5, sparse tomentum on anterior  $\frac{2}{3}$  of tergum 1. (22) *Sterna* brown to brown-black with metallic green tints basally on sternum 1; pubescence white and moderately long.

#### *Agapostemon mourei* n. sp.

This species is named after Padré J. S. Moure who has contributed so much to knowledge of the South American bee fauna.

The male holotype, the allotype and the paratypes (16 ♂, 2 ♀) are all labeled, "Region Chapare/ Bolivia 400 M./ VIII 1950 Zischka." All of

these types are in the Snow Entomological Museum at the University of Kansas.

**DISTRIBUTION.** This species seems to be sympatric with *A. boliviensis*. In the Snow Entomological Museum I have seen additional specimens (14 ♂, 3 ♀) from the type locality and specimens labeled as follows: "BOLIVIA-Beni, Rur-/ renabaque, 175 mts./ 5 October 1956/ (L. Pena)" (6 ♂); same as preceding but collected Oct. 17 (3 ♂); "BOLIVIA-Beni, Rey-/es. 10 December/ 1956 (L. Peña)" (2 ♂); "BOLIVIA- Chapare,/ Tropical Reg. 400/ mts. August 1951 (Zischka)" (3 ♂); same as preceding but 25 August 1950 (1 ♂); same as preceding but Oct. 1953 (5 ♂); "Cristal Mayu./ Chapare, Cochabamba Bol. 200 m./ VIII-4-49 L E Pena" (1 ♂); "Prov. del Sara/ Bolivia, 450 m./ J. Steinbech// Acc. 4548" (1 ♂); same as preceding but Acc. 5072 (1 ♂). In the U.S. National Museum I have seen specimens labeled: "nr. mouth/ Rio Mapiri/ Sept// Mulford/ Bio-Expl/ 1921-22" (3 ♂); "Covendo/ Boliv./ W M Mann// September// Mulford/ BioExpl/ 1921-22" (1 ♀); "Ixiamas/ Bolivia/ W M Mann// Dec// Mulford/ BioExpl/ 1921-22" (2 ♂); "Rosario, Lake/ Rogagua, Boliv/ W M Mann, Oct / 28-Nov. 9, 1921// Mulford/ Biol. Expl./ 1921-1922" (2 ♂).

**DIAGNOSIS.** The male may be distinguished from most other species by the presence of a medial "button" at the base of its last visible (6th) sternum. This sternal "button" is narrowed basally unlike that of the closely related *A. inca* (Figs. 139-140), and the hind femur, tibia and basitarsus are less slender than those of *A. inca* (Figs. 167-168). *Agapostemon mourei* may be distinguished from the related *A. lanosus*, *A. boliviensis* and *A. intermedius* by the larger and differently shaped medial plate of its gonostylus (Figs. 176, 177A-B, 192).

The female may be distinguished from most other species by the acute lateral angle and posterior lobe of its pronotum (Figs. 132-133) and by the dense woolly pubescence of its mesoscutum. It may be distinguished from *A. lanosus* by its bright yellow clypeal band and shallower genal striae; from *A. boliviensis* by its finer sculpturing and paler pubescence; from *A. heterurus* by the yellow on its clypeus and by the coppery luster of its head and mesosoma.

**VARIATION.** The general appearance of the males varies strikingly because the black markings of the appendages and metasoma are frequently replaced by pale amber markings.

#### DESCRIPTION

MALE (Figs. 127-128, 132-133, 139, 167, 176, 217)

General coloration of head and mesosoma bright metallic green to blue, metasoma with black and yellow or amber and yellow bands. **Head** (Figs. 127-128): with short creamy to yellow pubescence on interocular area and

vertex, becoming long and creamy to white on gena. (1) *Labrum* opaque lemon yellow with transparent pale amber margins,  $\frac{3}{4}$  as long as wide; antero-lateral margins forming obtuse angle at apex; large transverse ridge on basal  $\frac{1}{3}$  without median depression. Punctures on crown of basal ridge shallow and separated by several times their diameters; submarginal punctures large and shallow at apex becoming smaller laterally and disappearing just anterior to lateral margins of basal ridge. Pubescence restricted to minute scattered hairs on crown of basal ridge and single submarginal row of simple hairs deflected distally from antero-lateral margins. (2) *Clypeus* with large, shallow, sparsely scattered shallow punctures on lower (yellow)  $\frac{1}{2}$ - $\frac{2}{3}$ , becoming more abundant, slightly smaller and contiguous on upper (green)  $\frac{1}{3}$ - $\frac{1}{2}$ . (3) *Interocular area* with small, deep, contiguous punctures below ocelli, becoming medium-sized at level of antennal sockets and shallower, subcontiguous and smaller below antennae; supraclypeal protuberance with medium contiguous moderately deep punctures. (4) *Vertex* with small, deep, contiguous punctures anteriorly and laterally, becoming shallower and slightly larger between ocelli; transversely carinate posteriorly. (5) *Gena* with parallel, subcontiguous, short, weak carinae extending dorso-laterally from antero-ventral margin. (6) *Malar area* yellow, short, and with minute hairs. (7) *Mandible* yellow with apical  $\frac{1}{4}$ - $\frac{1}{3}$  amber. (8) *Antenna* dark brown to black, scape and pedicel yellow below. **Mesosoma:** pubescence short, pale fulvus to yellow on mesoscutum and mesoscutellum, becoming shorter and creamy to white posteriorly and ventro-laterally. (9) *Pronotum* (Figs. 132-133) with lateral angle and posterior lobe acutely pointed, lateral angle enlarged and projecting antero-laterally; with conspicuous sharp carina extending postero-ventrally from apex of lateral angle; with weak irregular rugae postero-laterally. Pubescence above lateral angle and posterior lobe pale fulvus to yellow, creamy to white below. (10) *Mesoscutum* with very large, conspicuous flange laterally on anterior margin extending antero-dorsally; punctures very fine, deep and contiguous. (11) *Mesoscutellum* with punctures slightly larger and shallower than those of mesoscutum and subcontiguous. (12) *Metanotum* deeply and moderately coarsely rugose. (13) *Mesepisternum* coarsely rugose anteriorly, becoming moderately rugose posteriorly. (14) *Metepisternum* moderately rugose with horizontal rugae slightly more prominent than other rugae. (15) *Propodeum* with propodeal carina nearly obliterated by extremely coarse and deep rugae posteriorly and dorsally; posterior and dorsal rugae becoming moderately fine, deep, contiguous punctures antero-laterally. (16) *Wing* sub-hyaline, tinted with amber on distal margins, veins and stigma brown. (17) *Tegula* pale transparent amber with anterior, submarginal, yellow crescent. (18) *Fore leg* yellow with brown streak posteriorly on coxa, trochanter, femur and tibia. (19) *Middle leg* elongate, yellow with brown



markings on posterior of trochanter, tibia and sometimes femur. (20) *Hind leg* (Fig. 167): femur sub-globose, tibia and basitarsus inflated. Coxa yellow below, dark brown with strong metallic tints above, trochanter dark brown, femur dark brown with yellow antero-dorsally, tibia dark brown sometimes streaked with yellow dorsally, and basitarsus varying from dirty yellow to dark brown. **Metasoma:** (21) *Terga* 2-6 very pale amber to dark brown-black on posterior  $\frac{2}{3}$  and yellow on anterior  $\frac{1}{3}$  (often partially concealed by overlap), tergum 1 with amber to brown-black band on anterior margin and brown to amber on anterior face; large, conspicuous, subcontiguous punctures anteriorly on tergum 1 becoming smaller posteriorly on tergum 1 and progressively smaller on posterior terga. Pubescence sparse and yellowish. (22) *Sterna* dark brown and with yellow or amber markings on sterna 1-3; sternum 6 (Fig. 139) with proximo-medial projection, or "button," with each lateral flange slightly more than  $\frac{1}{2}$  width of base (as measured on transverse section through widest part of "button"); pubescence moderately long, scattered, and pale fulvus to yellowish on exposed areas. (23) *Genitalia* (Figs. 176, 217).

## FEMALE (Figs. 125-126)

General coloration dark copper with tints of metallic green. **Head** (Figs. 125-126): with pubescence fulvus, becoming creamy on genal region. (1) *Labrum* dark amber to ferruginous. Basal ridge prominent, proximal face sloping gently toward proximal margin, distal face sharply declivous and delimited from basal area by carina; additional carina present between basal area and distal process; distal region narrow, rounded apically and with large central keel. Pubescence restricted to single submarginal row of coarse, stiff, amber bristles curving anteriorly at their apices and forming fimbria on antero-lateral margins of labrum. (2) *Clypeus* with shallow medial concavity; submarginal, yellow band broadly interrupted medially; punctures widely scattered on lower  $\frac{1}{2}$ , becoming sub-contiguous on upper  $\frac{1}{2}$ . (3) *Interocular area* with fine, moderately deep, contiguous punctures below ocelli, becoming finely rugose laterally and below; supraclypeal protuberance with moderate-size, subcontiguous punctures. (4) *Vertex* with fine, moderately deep, contiguous punctures anteriorly and laterally, and with fine, transverse striae posteriorly. (5) *Gena* with regular fine carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* amber to brown-black, very short, pubescence minute, white, appressed hairs. (7) *Mandible* yellow with apical  $\frac{1}{3}$  ferruginous. (8) *Antenna* dark brown to brown-black with flagellum pale yellowish amber below. **Mesosoma:** pubescence short, dense, woolly and pale ferruginous on meso- and metanotum, becoming sparse, moderately long and slightly paler below. (9) *Pronotum* like that of ♂ (Figs. 132-133) but with dense fulvus hair above lateral angle and posterior lobe. (10) *Mesoscutum* with small, deep,

contiguous punctures. (11) *Mesoscutellum* with punctures slightly smaller and shallower than those of mesoscutum. (12) *Metanotum* finely puncto-rugulose. (13) *Mesepisternum* with moderately coarse, shallow rugae anteriorly, becoming slightly finer posteriorly. (14) *Metepisternum* shallowly rugose with horizontal rugae predominant. (15) *Propodeum* with prominent propodeal carina; propodeal shield coarsely rugose, with horizontal rugae predominant; dorsal area coarsely and deeply rugose; lateral area with moderately coarse, deep striae extending from propodeal carina to anterior margin. (16) *Wing* as in ♂. (17) *Tegula* as in male, but slightly darker amber. (18) *Fore leg* brown with amber anteriorly on femur and tibia as well as dorsally and posteriorly; pubescence amber, becoming brown dorsally on tibia and tarsus. (19) *Middle leg* brown with amber anteriorly on tibia and femur and posteriorly on femur; pubescence pale amber, becoming dark brown to brown-black dorsally on tibia and tarsus. (20) *Hind leg* brown to brown-black, pubescence pale amber, becoming dark brown to black antero-dorsally on tibia and basitarsus. **Metasoma:** (21) *Terga* finely and contiguously punctate anteriorly with punctures becoming smaller and shallower posteriorly; amber with yellow on basal  $\frac{1}{3}$  of terga 2-5 and brown apically on tergum 5; pubescence short and sparse, pale amber anteriorly and dark brown posteriorly. (22) *Sterna* pale amber with brown basally on sterna 1, 4-6; long, sparse, yellowish pubescence on exposed areas.

### Agapostemon nasutus Smith

*Agapostemon nasutus* Smith 1853. Type ♂, British Museum (Natural History).

*Agapostemon peruvianus* Cameron 1903 (new synonymy). Type ♂, British Museum (Natural History).

*Agapostemon nasutus gualanicus* Cockerell 1912a (new synonymy). Type ♂, U.S. National Museum.

*Agapostemon purpureopictus* Cockerell 1924 (new synonymy). Type ♀, California Academy of Sciences, San Francisco.

*Agapostemon melanurus* Cockerell 1949 (new synonymy). Type ♀, U.S. National Museum.

I have seen the types of all the above forms except *A. nasutus* and *A. peruvianus*, which were examined for me by Michener. There is no doubt that they are all the same species. *A. nasutus gualanicus* Cockerell is an ill-defined geographic variant which does not seem to warrant formal recognition as a subspecies (see discussion of variation).

**DISTRIBUTION** (Fig. 7). *Agapostemon nasutus* is the most common and widespread of the tropical *Agapostemon*. Absent from the central plateau of Mexico, it occurs along the eastern coast as far north as Brownsville, Texas, and along the western coast as far north as Hermosillo, Sonora, and El Arco, Baja California. It is widespread in southern Mexico and Central America but has not been found in the wet Atlantic lowlands of Nicaragua, Costa Rica and Panamá. It has been collected along the coast of Venezuela as

far east as Trinidad, in the Cauca and Magdalena valleys of Colombia, and west of the Andes as far south as Ica, Perú.

It has been collected at or near sea level throughout its range and at elevations as high as 8,500 ft. (2,591 m) at Calderon, Ecuador; 1,200 m (3,963 ft.) at San José, Costa Rica; 5,000 ft. (1,524 m) at Guatemala City, Guatemala; and 6,400 ft. (1,951 m) at Tecamachalco, Puebla, Mexico. It has been collected in South America in every month but October, in Central America in every month but December and in Mexico north of the Isthmus of Tehuantepec in every month but January. Thus it seems that this species flies most, if not all, of the year wherever it occurs. My field observations in Costa Rica indicate that it is hard to find toward the end of the dry season, when flowers are also scarce.

**DIAGNOSIS.** Males are easily distinguished from all other species by the unique "hog-nosed" appearance of the broad, concave, ventral portion of the short clypeus (Figs. 85-87) and by sternum 6 which is broad with laterally directed disto-lateral tufts of branched hairs usually visible from above. Females, as well as males, may be distinguished from all other species without acutely pointed lateral pronotal angles by a yellow or creamy spot at the apex of the rounded posterior lobe of the pronotum (Fig. 134).

**VARIATION.** The females normally are metallic green on the head and thorax but in the central highlands of Central America (e.g., Gualán, Guatemala and San José, Costa Rica) the green is replaced by blue. This is the form named *A. nasutus gualanicus* by Cockerell. The same blue color is also found in many females from the southern limits of the range (e.g., Lima, Perú) and the northern limits of the range (e.g., Brownsville, Texas and Hermosillo, Sonora) where it may be very dark purple-blue.

Normally black, the abdomen is pale amber in the majority of females from coastal Venezuela. I have seen females with black or intermediate abdomens from this same region although these constitute less than 10% of the total sample (Fig. 7).

The amount of yellow on the males and females is quite variable and is slightly correlated with the coloration of the head and mesosoma of females. Blue females fly with males usually more extensively marked with black or brown than are males from regions where the metallic color of the females is green.

#### DESCRIPTION

MALE (Figs. 85-87, 153, 195, 221-223)

General coloration of head and mesosoma metallic green to blue-green or bronze, metasoma yellow with black bands. **Head** (Figs. 85-87): (1) *Labrum* yellow, 40% as long as broad, flattened basal area slightly concave, 20% as long as broad, distal area triangular, 85% as long as basal width and separated from it by sharp step. Distal area shiny, impunctate; basal area

with scattered punctures most abundant distally. Distal margin with row of about 32 widely separated bristles, stout medially, finer laterally, remainder of distal area glabrous; basal area with scattered, prostrate hairs directed distally, longest and most abundant distally and forming fringe on distal margin of basal area. (2) *Clypeus* with ventral area smooth and shiny, dorsal area shiny and coarsely punctate; flattened ventral area glabrous, at right angle to upper area which is densely covered with white to yellowish hairs. (3) *Interocular area* with dense, fine punctures below vertex, rugose laterally, coarsely punctate or rugose above antennal sockets; pubescence dense, white to yellowish hairs nearly as long as scape and much shorter along inner margins of eyes. (4) *Vertex* with dense fine punctures below and in ocellar triangle; coarsely and shallowly rugose behind ocellar triangle. (5) *Gena* with sparse, weak carinulae extending postero-dorsally from antero-ventral margin; pubescence dense, white (never yellowish), medially about 1.5 times as long as on interocular area. (6) *Malar area* yellow; pubescence sparse, white, tomentose. (7) *Mandible* yellow with apical third transparent ferruginous; nearly straight, not strongly curved as in other species. Pubescence on flat outer surface and posterior margin white to yellowish and directed apically; single longitudinal row of short simple bristles on inner surface. (8) *Antenna* (except scape and last two flagellomeres) dark brown above and light brown to yellow below; scape yellow with brown on apical  $\frac{1}{4}$ - $\frac{1}{2}$  above; last flagellomere brown with pale spot on upper side at apex; penultimate flagellomere brown, becoming yellow or light brown on basal  $\frac{1}{2}$  of underside. **Mesosoma:** metallic green, blue-green or bronze, with yellow or creamy spot on apex of posterior lobe of pronotum; moderately dense, white or creamy pubescence evenly distributed on all but anterior and lateral surfaces of pronotum. (9) *Pronotum* with lateral angle and posterior lobe rounded; 2-4 inconspicuous parallel carinae slanting rearwards and downwards near postero-lateral margin. Tomentum on lower lateral area white. (10) *Mesoscutum* densely covered with moderately deep, confluent punctures, fine posteriorly, becoming shallowly rugose on anterior  $\frac{1}{4}$ - $\frac{1}{3}$ . (11) *Mesoscutellum* with fine, moderately deep punctures separated by about their own diameters. (12) *Metanotum* moderately and shallowly rugose medially, rugulose laterally. (13) *Mesepisternum* coarsely and shallowly rugose anteriorly, becoming moderately rugose posteriorly. (14) *Metepisternum* with weak, parallel, interconnected, horizontal carinulae. (15) *Propodeum* coarsely and shallowly rugose laterally, rugae slightly coarser and deeper dorso-medially; propodeal carina weak, evenly rounded dorsally; propodeal shield weakly and irregularly carinulate. (16) *Wing* pale, transparent brown, not darkened apically, radius much darker than other veins. (17) *Tegula* yellow with large transparent area in center of posterior half and transparent on posterior, distal and anterior margins.

(18) *Fore leg* yellow, sometimes with brown on posterior surface of coxa, trochanter and base of femur. Pubescence on coxa, trochanter and basal  $\frac{1}{2}$  of femur sparse, long, white and branched; on tarsus, tibia and apex of femur sparse, short, simple, white to yellowish. (19) *Middle leg* yellow, coxa brown; trochanter and posterior area of femur sometimes brown; pubescence like that of fore leg. (20) *Hind leg* (Fig. 153) with coxa brown, becoming green dorsally; trochanter brown; brown streak on basal  $\frac{3}{4}$  of posterior surface of femur; tibia and tarsus yellow; on some specimens with brown on basal  $\frac{3}{4}$  of tibia and all but anterior of femur; pubescence similar to that of preceding legs except posterior surfaces of basitarsus and femur which are densely covered with short, stiff, simple, yellow hairs directed distally. **Metasoma:** (21) *Terga* 1-6 transparent apically, each with subapical brown or black band slightly broader than transparent area (may seem broader if abdomen is flexed and brown basal band of underlying tergum shows through overlapping transparent margin of preceding tergum), central yellow band almost twice as wide as subapical black band, and narrow brown or black basal band; tergum 1 with additional yellow basal region; tergum 7 brown or black; pygidial plate fawn to yellow. Pubescence fine and short dorsally, longer laterally, at base of tergum 1, and on posterior margins of terga 5-7; white except on dark portions of terga 5-7 where yellow or brown; terga shiny with small, shallow punctures separated by about their own diameters. (22) *Sterna* 2-5 yellow, each with subapical brown band, apical margin transparent, narrow brown basal band often concealed by overlap of preceding sternum but sometimes so broad as to be confluent with subapical brown band; sternum 1 brown, tinged with green basally, paler subapically, distal and lateral margins transparent; sternum 6 yellow with basal brown band and transparent distal margin; yellow areas on abdominal sterna sometimes partially or completely replaced by brown; sternum 6 very broad with disto-lateral bulge and longitudinal medial ridge; sternum 1 with few scattered long white hairs and thin fringe of short hairs on distal margin; sterna 2-5 with scattered long yellow hairs subapically, distal margins fringed with short, prostrate hairs, basal  $\frac{1}{4}$  of each with minute, simple, white hairs; sternum 6 with numerous long yellowish hairs conspicuously branched, short medially but with long disto-lateral tufts directed postero-laterally and usually visible from above. (23) *Genitalia* (Figs. 195, 221-223) far more complex than those of other species, and relatively large.

FEMALE (Figs. 41-42, 134)

General coloration of head and thorax metallic green to blue. Metasoma black or pale amber, with white bands of fine pubescence. **Head** (Figs. 41-42): pubescence short ( $\frac{1}{2}$ - $\frac{1}{4}$  as long as shortest distance between antennal sockets) and white or yellowish on face, twice as long on gena and pure



white. (1) *Labrum* dark amber to ferruginous. Basal ridge prominent, proximal face sloping gently toward proximal margin, distal face sharply declivous, and apex of ridge with deep punctures; distal portion narrow, abruptly rounded at apex; conspicuous median keel on antero-distal portion, continued basally almost to basal ridge; anterior margin of keel flattened and slightly flared laterally; single row of dark amber, wide, flat, stiff bristles curving anteriorly at their apices forming fimbria on lateral margins of distal portion of labrum. (2) *Clypeus* green above with yellow band on lower  $\frac{1}{2}$ - $\frac{2}{3}$  bordered with black; yellow almost entirely replaced with dark brown or black on darker specimens; median subapical area slightly concave, yellow band with large scattered punctures, upper green area with numerous short horizontal carinulae or horizontally elongate punctures. (3) *Interocular area* coarsely and shallowly rugose, supraclypeal protuberance with dense, long, horizontal carinulae. (4) *Vertex* densely and finely punctate between, anterior to, and lateral to ocelli; coarsely and shallowly rugose behind ocelli. (5) *Gena* with numerous weak, contiguous rugulae running postero-dorsally from antero-ventral margin. (6) *Malar area* brown and very short. (7) *Mandible* yellow, apical  $\frac{1}{3}$  ferruginous. (8) *Antenna* dark brown to black, slightly paler brown on underside of flagellum.

**Mesosoma:** pubescence (except on pronotum) nearly twice as long as on face, moderately dense, white laterally and below, but may be yellowish or fuliginous on mesoscutum and mesoscutellum of blue specimens. (9) *Pronotum* (Fig. 134) with yellow to creamy spot at apex of posterior lobe; lateral angle and posterior lobe rounded as in  $\delta$ ; faint punctures on dorsal portion and faint parallel striae running downward and rearward on lower lateral area; pubescence white, very fine, short, and appressed on lower lateral area. (10) *Mesoscutum* as in  $\delta$ . (11) *Mesoscutellum* finely and densely punctate anteriorly, becoming coarsely punctate posteriorly; shiny, less densely punctate area lateral to center. (12) *Metanotum* rugulose. (13) *Mesepisternum* coarsely rugose anteriorly, somewhat less coarsely so posteriorly. (14) *Metepisternum* as in  $\delta$ . (15) *Propodeum* coarsely rugose dorsally and postero-laterally, becoming finely striate antero-ventrally; propodeal carina prominent, strongly curved dorso-laterally, weakly convex dorsally; propodeal shield with irregularly anastomosing carinulae running laterally and slightly upward from mid-line. (16-17) *Wing* and *tegula* as in  $\delta$ . (18) *Fore leg* brown to black with yellow on anterior apical  $\frac{1}{3}$  of femur and basal  $\frac{2}{3}$  of tibia, may be more extensive on pale specimens; pubescence of coxa, trochanter and femur white, becoming yellow on tibia and tarsus. (19) *Middle leg* similar in color and pubescence to fore leg but pubescence on dorsal surface of tibia and tarsus fuliginous. (20) *Hind leg* brown to black, pubescence similar to that of middle leg but even darker on dorsal surface of tibia and tarsus and with pale penicillus at apex of

basitarsus. **Metasoma:** (21) *Terga* usually black but often pale amber with black at apices of terga 4-6 in Colombian and Venezuelan specimens; anterior vertical portion of tergum 1 with sparse white hairs, upper  $\frac{1}{2}$  with thin white tomentum; basal halves of terga 2-4 with dense white tomentum; prepygidial fimbria and hairs adjacent to pygidium and on apical portion of tergum 4 brown to black. (22) *Sterna* brown to black, often pale amber in Colombian and Venezuelan specimens; long, scattered, whitish pubescence on exposed portions.

### **Agapostemon obscuratus** Cresson

*Agapostemon obscurata* Cresson 1869. Type ♂ (not ♀), Academy of Natural Sciences, Philadelphia.

*Agapostemon obscuratus*. Dalla Torre, 1896.

*Agapostemon obscuratus abjectus* Cockerell 1917b (new synonymy). Type ♂ (not ♀), U.S. National Museum.

By peculiar coincidence the descriptions by both Cresson and Cockerell are headed by the symbol "♀", but both descriptions are of males. I have seen the types of *A. obscuratus* and *A. obscuratus abjectus* and both specimens are males. The color differences described by Cockerell were not visible to me.

The specific rank of *A. obscuratus* is questionable, as I am unable to find any differences between specimens of *A. viridulus* and *A. obscuratus* other than the replacement of metallic coloration on the former by dark green-black on the latter. The sympatric distribution of *A. obscuratus* and *A. viridulus* and the absence of intermediate forms seems to refute any contention that they are merely subspecies. It is possible that they are a single species with two color phases. In the absence of biological data, I choose the simplest solution and regard *A. obscuratus* as specifically distinct from *A. viridulus*.

**DISTRIBUTION.** I have seen specimens from Habana, Cuba (Jan., 4 ♂; Feb., 2 ♂; April, 1 ♂; Sept., 1 ♂; Dec., 3 ♂; 15 ♂ and 2 ♀, no date).

**DIAGNOSIS.** Both sexes may be distinguished from all other West Indian species of *Agapostemon* by their total lack of metallic coloration.

**DESCRIPTION.** As in *A. viridulus* but for the color differences mentioned above.

### **Agapostemon ochromops** n. sp.

The name of this species refers to the pale yellowish eyes of both sexes.

The male holotype is labeled, "Bahamas/Mariguana [Mayaguana?] /22-II//Greenway/coll." The female allotype and paratype are labeled, "Bahamas/Mariguana [Mayaguana?] /25-II//fls. Cañile//Fairchild/coll." All of these types are in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

**DISTRIBUTION.** Aside from the type series listed above, I have seen

specimens collected on the following Bahamian islands: Rum Cay (Feb.; 23 ♂, 3 ♀), Cat I. (March; 1 ♀), Conception [Conception?] I. (Feb.; 9 ♂, 1 ♀) and New Providence I. (1 ♂).

**DIAGNOSIS.** Both sexes may be distinguished from *A. centratus*, *A. kohliellus*, *A. obscuratus*, *A. hispaniolicus*, *A. viridulus*, *A. swainsonae*, *A. cubensis*, *A. alayoi*, *A. insularis*, *A. jamaicensis*, *A. poeyi*, *A. viequesensis*, *A. columbi* and *A. aenigma* by their pale milky eyes and creamy to yellow pigment on the underside of the pterostigma. The female is metallic green in contrast to the metallic dark blue of *A. sapphirinus* and the metallic dark purple of *A. cyaneus*. The male may be distinguished from *A. cyaneus* by the pale yellow to amber of the underside of its pedicel but is indistinguishable from males of *A. sapphirinus*.

**VARIATION.** The anterior surface of the first metasomal tergum of the allotype is honey-colored with an interrupted yellow band. On the other males the honey-color is replaced by light to dark brown. The brown on the legs is lightest on the allotype and darker on the other males. Metallic color varies in intensity and varies from blue-green to green both between and within island populations. The genal carinulae of females are finest and most numerous on the specimen from Conception I., most coarse and fewest on specimens from Rum Cay, and intermediate on the holotype and paratype from Mariguana (Mayaguana?) I.

This is the most heterogeneous of the Bahamian species and it may be a composite species. Only more collections from the Bahamas can resolve the problem.

#### DESCRIPTION

##### MALE (Fig. 225)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma brown to amber banded with yellow. **Head:** as in *A. viequesensis* but with eyes pale milky to yellowish, and ferruginous apical portion of mandible slightly reduced. **Mesosoma:** as in *A. viequesensis* but with slightly coarser sculpturing, with creamy to yellow pigment on pterostigma and on underside of larger wing veins. **Metasoma:** as in *A. viequesensis* but pygidium with apex more acute (Figs. 224-225), metasomal terga 3-5 of the holotype and a specimen from Rum Cay with faint metallic tints and with pale bands slightly paler and dark bands slightly darker than in *A. viequesensis*, and genitalia with apex of distal stylus of gonostylus more spoon-shaped than in *A. viequesensis* (but not so much as in *A. poeyi*).

##### FEMALE

Like *A. viequesensis* but with eyes milky to yellowish; with creamy to yellow pigment on pterostigma and underside of larger wing veins; and with

sculpturing less coarse than in *A. poeyi*, but coarser than in *A. viequesensis* (closer to the latter), and somewhat more variable than in other West Indian species (even within island populations).

### *Agapostemon peninsularis* n. sp.

The name of this species refers to the Baja California peninsula where it is found.

The male holotype, the allotype and nine male paratypes are all labeled, "Mgdlena Bay/Lower Cal./May 30, 1925//H. H. Keifer/Collector" and are all in the California Academy of Sciences, San Francisco.

**DISTRIBUTION.** In addition to the type locality above I have seen specimens from the following localities: Ensenada (1 ♀, 31 May; 1 ♂, 24 June; 3 ♂, 30 Aug.), Camalu (1 ♀, 23 June), 3 miles south of San Quintin (3 ♀, 8-12 March), 20 miles west of San Augustine (1 ♂, 24 Sept.), and 20 miles north of Mesquital (1 ♂ & 1 ♀, 27 Sept.), Baja California, Mexico; San Diego (1 ♂) and La Jolla (1 ♂, 16 July), California.

**DIAGNOSIS.** The male may be distinguished from most species by its lack of a prominent hind femoral tooth and by the black streak extending from the base of the posterior surface of its hind femur to the apex of the posterior surface of its hind tibia; and from *A. mexicanus* by the lack of enlarged submarginal bristles medially on its 4th metasomal sternum (only two to four submarginal bristles are present on each side). The female may be distinguished from many species by its black metasoma, bright green head and thorax, transverse yellow clypeal band, and rounded lateral pronotal angle; from *A. tyleri* by the lack of a smooth shiny (with scattered punctures) area centrally on its supraclypeal protuberance; from *A. nasutus* by the absence of a creamy spot on the apex of its pronotal lobe; from *A. leunculus* by the white to creamy pubescence (brown to black in *A. leunculus*) around the basitibial plate on its hind leg; from *A. melliventris* by the finely rugulose dorso-medial region of its propodeum (rugose in *A. melliventris*).

### DESCRIPTION

MALE (Figs. 88-89, 157, 190, 205)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma banded with black and yellow. **Head** (Figs. 88-89): pubescence white. (1) *Labrum* as in *A. texanus* but more obtuse apically. (2) *Clypeus* as in *A. melliventris* but with transverse yellow band slightly narrower and with medial enlargement only about  $\frac{1}{2}$  as great. (3-5) *Interocular area*, *vertex* and *gena* as in *A. melliventris* but with sculpturing slightly coarser. (6-7) *Malar area* and mandible as in *A. melliventris*. (8)

*Antenna* with scape and pedicel brown-black above and yellow below to entirely brown-black; flagellum brown-black above, becoming pale amber to yellow below. **Mesosoma:** pubescence white. (9-12) *Pronotum*, *mesoscutum*, *mesoscutellum* and *metanotum* as in *A. melliventris*. (13) *Mesepisternum* more coarsely rugose than metanotum (especially anteriorly). (14) *Metepisternum* with interconnected horizontal carinulae, becoming rugose posteriorly in some specimens. (15) *Propodeum* with propodeal carina usually absent but may be visible as very weak carina dorsally; propodeal shield very coarsely and shallowly rugose; dorsal area moderately rugose laterally, becoming very finely and shallowly rugose medially; lateral area coarsely and shallowly rugose posteriorly, becoming moderately finely rugose anteriorly. (16) *Wing* as in *A. melliventris* but with veins darker brown. (17) *Tegula* pale transparent amber with submarginal yellow band anteriorly and posteriorly, and with strong metallic tints basally. (18) *Fore leg* with coxa metallic green; trochanter brown-black with metallic green tints basally and apical yellow spot anteriorly; femur yellow with broad brown-black streak postero-dorsally extending from base almost to apex; tibia yellow with brown-black streak ventrally; tarsus yellow. (19) *Middle leg* as fore leg but with brown-black ventral streak on tibia extending to posterior surface. (20) *Hind leg* (Fig. 157) as fore leg but with yellow spot on trochanter ventral; with brown to brown-black streak on femur posterior, extending to apex, and extending dorsally at apex; tibia with brown to brown-black streak posterior and extending dorsally at base and apex. Femur without distinct tooth and basitarsus without apical groove or basal ridge. **Meta-soma:** (21) *Terga* 2-6 black with yellow band on basal  $\frac{1}{2}$  (usually partially obscured by overlapping terga posteriorly); tergum 1 black with yellow band centrally; terga 1-6 with posterior and ventro-lateral margins transparent; tergum 7 with pygidium dark amber to brown-black. Pubescence white, dark brown on postero-dorsal  $\frac{1}{2}$  of terga 1-4; moderately long, becoming short and appressed dorsally on terga 1-4. (22) *Sterna* 2-5 yellow with brown-black bands basally and anteriorly (these bands very narrow on sternum 2, becoming progressively broader on posterior sterna until yellow nearly absent on sternum 5), sternum 1 with strong metallic tints, sternum 6 brown-black with small medial ridge in shallow depression on apical  $\frac{1}{2}$ . Pubescence long and pale on exposed areas, sternum 4 with 2-4 large hooked bristles at each postero-lateral margin. (23) *Genitalia* (Figs. 190, 205) with medium-sized ventral lobe on gonocoxite fringed with hairs.

## FEMALE (Figs. 65-66)

General coloration of head and mesosoma bright metallic green, metasoma black. **Head** (Figs. 65-66): as in *A. melliventris* but with transverse band on clypeus narrower and bordered with brown-black, and with scape



entirely brown-black. **Mesosoma:** pubescence white, becoming creamy on mesonotum and pronotum. (9-14) *Pronotum*, *mesoscutum*, *mesoscutellum*, *metanotum*, *mesepesternum* and *metepisternum* as in *A. melliventris*. (15) *Propodeum* with weak propodeal carina; propodeal shield with large but very shallow rugae; dorsal area finely rugose laterally, becoming very finely rugulose medially; lateral area with shallow, anastomosing horizontal carinulae anteriorly, becoming shallowly rugose posteriorly. (16) *Wing* as in ♂. (17) *Tegula* as in *A. melliventris*. (18-19) *Fore* and *middle legs* with coxa dark brown tinged with metallic green; trochanter dark brown; femur dark brown with yellow apically; tibia yellow with dark brown streak ventrally; tarsus yellow. (20) *Hind leg* brown, coxa metallic green dorsally. **Metasoma:** pubescence white. (21) *Terga* brown-black to black. Pubescence moderately long, becoming short and appressed dorsally on terga 1-4; dense tomentum on basal  $\frac{1}{2}$  of terga 2-5 and on all but posterior  $\frac{1}{3}$  of tergum 1. (22) *Sterna* brown-black to black; moderately long pubescence on exposed areas.

### Agapostemon poeyi (Lucas)

*Andrena poeyi* Lucas 1856. Type ♀, Gribodo collection, Museo Civico di Storia Naturale, Genoa.

*Agapostemon festivus* Cresson 1865 (new synonymy). Type ♂, Academy of Natural Sciences, Philadelphia.

*Halictus (Agapostemon) chalcis* Vachal 1903 (new synonymy). Type ♀, Naturhistorisches Museum, Vienna.

The "type" of *Andrena poeyi* has been examined by C. D. Michener. He states that it is labeled "*Andrena poeyi* Guérin Cuba Type" but notes that the word "type" is not in Guérin's hand. While this specimen may not be the type, I am regarding it as such until such time as a more likely candidate is found. The description coupled with the type locality leave little doubt as to the identity of this species. I have seen the type of *A. festivus* and it is obviously the male of *A. poeyi*. I have seen the type of *H. chalcis* and it is unquestionably conspecific with *A. poeyi*.

**DISTRIBUTION.** I have seen about 70 specimens from Cuba; males have been collected in all months but January, June, October and December and females have been collected in January, April, June, September and November. I have also seen specimens from Guaiameti, Santo Domingo, Hispaniola (1 ♂, July); Arthurs Town, Cat I., Bahamas (1 ♀, July-Aug.); Mangrove Cay [part of Andros I.], Bahamas (1 ♀, 1 Aug.); Nassau, New Providence I., Bahamas (5 ♀, 12 Aug.; 1 ♀, Nov.; 1 ♂, 16 Dec.; 7 ♂ & 3 ♀).

I have also seen three males of this species labeled "Mexico-Veracruz,/ Nogales/April 1956/(N. L. H. Krauss)." In his revision of the banded subgenera of *Nomia*, D. W. Ribble (1965) noted specimens of the Cuban *Nomia robinsoni* with these label data and questioned the correctness of the labels.

In the face of this additional evidence it seems almost certain that the labels are incorrect.

**DIAGNOSIS.** Both sexes may be distinguished from those of *A. cyaneus*, *A. sapphirinus* and *A. ochromops* by their lack of milky to yellowish eyes or pterostigma. The male may be distinguished from *A. columbi* and *A. viequesensis* by its strong metallic green to blue tints medially on metasomal tergum 3; from *A. insularis* by its metallic blue to green tints postero-laterally on tergum 1; and from *A. jamaicensis* by its narrower hind femora. The female may be distinguished from *A. centratus*, *A. alayoi*, *A. obscuratus*, *A. hispaniolicus*, *A. viridulus* and *A. swainsonae* by its bright metallic green metasomal terga; from *A. viequesensis* by the basal green spot on its mandible; from *A. columbi* and *A. aenigma* by its conspicuous metallic green tints medially on metasomal sterna 3-4; from *A. insularis* by its rugose area adjacent to the parapsidal line.

#### DESCRIPTION

##### MALE (Figs. 144, 186, 210)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma dark brown with yellow bands. **Head:** color and shape as in *A. viequesensis*; sculpturing very slightly coarser than in *A. viequesensis*; pubescence of clypeus, interocular area and vertex yellowish to pale amber, that of gena white. **Mesosoma:** pubescence as in *A. viequesensis*. (9) *Pronotum* with lateral angle and posterior lobe more angular than in *A. viequesensis*; carinulae on postero-lateral area larger and fewer in number than in *A. viequesensis*. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. viequesensis* but with very slightly coarser sculpturing. (13-15) *Mesepisternum*, *metepisternum* and *propodeum* as in *A. viequesensis* but with much coarser sculpturing. (16) *Wing* as in *A. viequesensis* but with veins darker. (17) *Tegula* with dark amber to brown almost obscuring yellow band, metallic green tints antero-basally slightly more extensive than in *A. viequesensis*. (18-19) *Fore* and *middle legs* with coxae metallic green (only weakly tinted on middle leg), trochanters brown with amber to yellow on anterior surface, femora yellow with apical, brown postero-dorsal spot, tibiae yellow with brown postero-dorsally, and tarsi yellow to pale amber (some specimens from New Providence I. with brown areas on fore leg reduced); pubescence slightly darker than that of *A. viequesensis*. (20) *Hind leg* (Fig. 144) as in *A. viequesensis* but with brown areas much darker, with femur, tibia and basitarsus less swollen, and with ridge and apical groove on basitarsus narrower and less prominent. **Metasoma:** (21) *Terga* as in *A. viequesensis* but with brown areas darker, with apex of pygidium nearly as acute as that of *A. ochromops* (Figs. 224-225), and with metallic green replacing brown completely on terga 4-6 and partially on 2-3.

(22) *Sterna* as in *A. viequesensis* but slightly darker and with small metallic medial green spot on transverse submarginal ridge of sternum 4. (23) *Genitalia* (Figs. 186, 210) with apex of apical stylus on gonostylus enlarged like bowl of spoon. Ventral lobe large, with fringe of hairs on lower margin.

FEMALE (Figs. 8, 10, 12, 14, 16)

General coloration of head, mesosoma and metasoma bright green to blue-green. **Head:** pubescence as in *A. viequesensis*. (1) *Labrum* as in *A. hispaniolicus*. (2) *Clypeus* with broad, deep punctures on brown-black portion becoming deeply rugose on upper  $\frac{1}{2}$ . (3) *Interocular area* deeply rugose, with rugae largest just above antennal sockets; supraclypeal protuberance rugose. (4) *Vertex* finely rugose anteriorly, becoming coarsely rugose laterally and posteriorly. (5) *Gena* with less than ten extremely large rugae extending postero-dorsally from antero-ventral margin (Fig. 16). (6) *Malar area* as in *A. viequesensis*. (7) *Mandible* as in *A. viequesensis* but with basal area darkened and with metallic basal spot. (8) *Antenna* brown-black, slightly paler on underside of flagellum, apex of apical flagellomere sometimes conspicuously paler than other flagellomeres. **Mesosoma** (Figs. 8, 10, 12, 14): with pubescence as in *A. viequesensis*. (9) *Pronotum* with lateral angle and posterior lobe slightly angular; dorsal portions of lateral angle and posterior lobe rugose and separated from lower portion by distinct carina extending from lateral angle to posterior lobe; postero-lateral area with 3-6 strong horizontal carinae. (10) *Mesoscutum* very coarsely rugose laterally and anteriorly, becoming coarsely and contiguously punctate medially and posteriorly. (11-12) *Mesoscutellum* and *metanotum* as in *A. viequesensis*. (13) *Mesepisternum* evenly, extremely deeply and coarsely rugose. (14) *Metepisternum* with extremely coarse horizontal carinae. (15) *Propodeum* with very strong propodeal carina; propodeal shield with strong carinae extending dorso-laterally from medial groove; dorsal area with extremely coarse carinae extending postero-laterally from antero-dorsal margin; lateral area with coarse, anastomosing carinae extending from metepisternum to lateral portion of propodeal carina. (16) *Wing* as in *A. viequesensis* but with veins darker. (17) *Tegula* as in *A. viequesensis* but with amber replaced by dark brown, metallic tints slightly more extensive, and yellow band largely or wholly obscured. (18-20) *Fore, middle and hind legs* dark brown with coxae wholly to partially covered with bright metallic green (least on middle coxa); pubescence as in *A. viequesensis* but darker (almost black) dorsally on middle tibia, hind tibia and apex of hind femur. **Metasoma:** (21) *Terga* as in *A. viequesensis* but with central brown bands absent or very faint. (22) *Sterna* dark brown with strong metallic tints on all or most of exposed portions; pubescence as in *A. viequesensis*.

**Agapostemon radiatus** (Say)

*Halictus radiatus* Say 1837. Type probably destroyed.

*Agapostemon pulchra* Smith 1853. Type ♂, British Museum (Natural History).

*Agapostemon sulcatulus* Cockerell 1909. Type ♂, U.S. National Museum.

The type of *Halictus radiatus* has probably been destroyed, but the description leaves no doubt of its identity. Michener has examined the type of *Agapostemon pulchra* (which is not labeled "California" as reported by Sandhouse, 1936) and I have examined the type of *Agapostemon sulcatulus*.

DISTRIBUTION (Fig. 18). Specimens have been collected as far north as Treesbank, Manitoba; as far south as Orange Co. in central Florida; as far east as Cape Cod, Massachusetts; and as far west as Sioux Co., Nebraska. In the northern part of the range (Wisconsin) females have been collected from April through October and males from July through October. In the central part of its range (Kansas) females have been collected from April through November and males in April and July through November. In the southern part of its range females have been collected from April through September and males from June through August and in October. Most abundant at elevations of less than 2,000 ft. (610 m), *A. radiatus* has been collected as high as 4,100 ft. (1,250 m) in the Smoky Mountains of North Carolina.

DIAGNOSIS. The male may be distinguished from many species by the yellow maculations on its 6th metasomal sternum and by the tooth on its hind femur; from *A. melliventris* by the brown-black on the anterior surface of its first metasomal tergum; from *A. texanus* and *A. angelicus* by its lack of conspicuous metallic tints on metasomal tergum 4, and by its lack of a broad, subapical, transverse ridge on metasomal sternum 4; and from males of *A. splendens*, *A. cockerelli* and *A. femoratus* by its unmodified hind basitarsus. The female may be distinguished from many species by its metallic green metasomal terga; from *A. texanus* and *A. angelicus* by its coarsely punctate or rugose mesoscutum without punctures of two distinct sizes; from *A. splendens* by its smaller size, coarse parallel carinae dorso-medially on its propodeum, its bright yellow mandibles (ferruginous apically), and its very pale amber to clear wings; from *A. femoratus* by its mesoscutum (coarsely punctate with rugae anteriorly and laterally in *A. radiatus*, almost entirely coarsely rugose in *A. femoratus*). The female cannot be morphologically differentiated from females of *A. cockerelli* but may be distinguished by its eastern distribution.

## DESCRIPTION

## MALE (Figs. 105-106, 161)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma with black and yellow bands. **Head** (Figs. 105-106):

pubescence white, pale yellowish on interocular area, becoming pale amber on vertex. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with large scattered punctures below, becoming weakly rugose above. (3) *Interocular area* with very deep, fine, contiguous punctures below vertex, becoming weakly and finely rugose at level of and below antennal sockets; supraclypeal protuberance rugose. (4) *Vertex* finely and deeply punctate below ocelli and laterally, becoming deeply rugulose behind and between ocelli. (5) *Gena* with short, weak, parallel, well separated carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* bright yellow; very short. (7) *Mandible* bright yellow with apical  $\frac{1}{4}$ - $\frac{1}{3}$  dark ferruginous. (8) *Antenna* brown-black above with apical  $\frac{1}{2}$  of apical flagellomere amber; underside of flagellum amber to pale amber; underside of scape and pedicel bright yellow (underside of pedicel sometimes brown). **Mesosoma:** pubescence white, becoming yellowish to fuliginous on mesonotum and metanotum. (9) *Pronotum* with distinctly, but not acutely, angular lateral angle and posterior lobe; distinct carina extending postero-ventrally from lateral angle; distinct vertical carina laterally; and numerous weak horizontal carinulae. (10) *Mesoscutum* with fine, deep, contiguous punctures becoming rugose antero-laterally. (11) *Mesoscutellum* with fine, deep, contiguous punctures medially, becoming scattered in shiny lateral area. (12) *Metanotum* finely but deeply rugulose. (13) *Mesepisternum* moderately deeply and moderately coarsely rugose anteriorly, becoming slightly less deeply and coarsely rugose posteriorly. (14) *Metepisternum* moderately deeply and moderately coarsely rugose. (15) *Propodeum* with strong propodeal carina; propodeal shield moderately deeply and moderately coarsely rugose; dorsal area with short, coarse, parallel carinae extending postero-laterally from anterior margin, becoming moderately deeply and moderately coarsely rugose posteriorly (entire dorsal area rugose on some specimens); coarsely rugose postero-laterally, becoming punctate or finely rugulose antero-laterally. (16) *Wing* very pale brown, slightly darker on distal margin; veins and pterostigma pale brown, radial vein very dark brown. (17) *Tegula* amber with metallic tints antero-basally, with yellow on posterior margin, and with yellow submarginal band anteriorly. (18) *Fore leg* yellow; coxa metallic green and with small brown stripe posteriorly on tibia; pubescence yellowish to amber. (19) *Middle leg* with coloration and pubescence like fore leg with small, brown, subapical spot dorsally on femur and with brown posterior stripe on tibia larger. (20) *Hind leg* (Fig. 161) with coxa metallic green; trochanter brown to amber with yellow on apical  $\frac{1}{2}$  of lower side (extending to base on some specimens); femur yellow with brown spot dorsally at apex and sometimes posteriorly at base (much smaller than apical spot); tibia yellow with small brown to amber spot apically on anterior surface, with brown stripe antero-dorsally often connected with brown basal spot;



tarsus yellow, basitarsus lacking basal ridge and apical groove. Pubescence yellowish to amber. **Metasoma:** (21) *Terga* black with yellow bands on basal halves of terga 2-6 and centrally on tergum 1; ventro-lateral margins of terga 1-6 transparent amber; and sometimes with faint metallic tints anteriorly on tergum 1 and postero-laterally on tergum 3. Pubescence dorsally on terga 1-4 very short and inconspicuous, pale on yellow bands, dark on brown bands; moderately long, yellowish pubescence anteriorly on tergum 1 and laterally on terga 1-4; moderately long and dark brown dorsally and laterally on terga 5-7. (22) *Sterna* yellow with narrow brown band on distal margin of sternum 2 pale and slightly broadened medially, becoming progressively darker and larger on sterna 3-5; sternum 6 with brown medial stripe varying from very narrow to  $\frac{1}{2}$  width of sternum; sternum 1 metallic green basally. Broad, low, transverse, subapical (not apical as in *A. texanus* and *A. angelicus*) ridge on sternum 4, most prominent laterally, and often with faint metallic tints medially; moderately long scattered hairs on exposed areas, 2-4 large stout bristles disto-laterally on sternum 4. (23) *Genitalia* indistinguishable from those of *A. femoratus*.

#### FEMALE (Figs. 55-56)

General coloration of head, mesosoma and metasoma bright metallic green to blue-green. **Head** (Figs. 55-56): pubescence white, becoming pale yellowish amber on vertex and, commonly, on interocular area. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with punctures deep, scattered below, becoming subcontiguous and interspersed with weak horizontal rugae above. (3) *Interocular area* with coarse, deep, contiguous punctures dorso-medially, becoming moderately rugose laterally and ventrally; supraclypeal protuberance sparsely punctate and with weak horizontal carinae. (4) *Vertex* with coarse, deep, contiguous punctures anterior to ocelli, becoming more shallowly punctate or finely rugulose laterally; shallowly and finely rugose posteriorly and between ocelli. (5) *Gena* with moderate to coarse, contiguous, parallel carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* dark amber to dark brown; very short, nearly absent. (7) *Mandible* yellow with apical  $\frac{1}{2}$ - $\frac{1}{3}$  dark ferruginous. (8) *Antenna* brown-black with underside of flagellum very slightly paler than upperside. **Mesosoma:** pubescence white, becoming slightly yellowish to fuliginous on mesonotum and metanotum. (9) *Pronotum* as in  $\delta$ . (10) *Mesoscutum* with deep, contiguous, moderately large punctures becoming rugose anteriorly and antero-laterally. (11) *Mesoscutellum* with small subcontiguous punctures medially, becoming larger and scattered on shiny lateral area. (12) *Metanotum* finely and shallowly rugulose. (13) *Mesepisternum* deeply and coarsely rugose anteriorly, becoming slightly less coarsely and less deeply rugose posteriorly. (14) *Metepisternum* with even, parallel, horizontal

carinae anastomosing posteriorly (on some specimens becoming rugose posteriorly). (15) *Propodeum* with very strong and prominent propodeal carina; propodeal shield weakly rugose (rugae often absent on upper margin); dorsal surface with very coarse, irregular and anastomosing carinae extending posteriorly from anterior margin; postero-lateral margin with moderately coarse horizontal carinae, becoming much finer and weaker antero-laterally. (16) *Wing* as in ♂. (17) *Tegula* as in ♂ but slightly darker. (18-19) *Fore* and *middle legs* dark brown to brown-black with coxae metallic green and with antero-dorsal pale amber to yellowish areas apically on femora and basally on tibiae; pubescence white to pale fuliginous or amber. (20) *Hind leg* dark brown to brown-black with metallic tints dorsally on coxa; pubescence creamy, becoming amber posteriorly on tarsus and dark brown to brown-black dorsally on tibia. **Metasoma:** (21) *Terga* with very fine subcontiguous punctures on metallic regions; pubescence white, becoming brown-black on terga 5-6; terga 2-4 with narrow band of tomentum basally, otherwise largely devoid of hairs; moderately long hairs anteriorly on tergum 1, laterally on terga 1-5, and dorsally on terga 5-6. (22) *Sterna* brown to brown-black with metallic tints basally on sternum 1 and some specimens with very weak metallic tints on sternum 4; exposed areas with long, white, scattered hairs.

### **Agapostemon rhopalocera** Smith

*Agapostemon rhopalocera* Smith 1853. Type ♂, British Museum (Natural History).

The type of this rare and peculiar species was examined at the British Museum by C. D. Michener. I know of only two additional specimens (males), both loaned to me by the British Museum.

**DISTRIBUTION.** The holotype is from "Mexico." The other two males were collected in May, 1913-14 at Atoyac, Vera Cruz, Mexico. This town lies just 3.5 km ESE of Pico de Orizaba at an elevation of about 600 m (1,968 ft.). As well as this area has been collected, it is surprising that no more specimens have been collected in the past 50 years. Perhaps the habitat of this species has been destroyed by human activities.

**DIAGNOSIS.** The male may easily be distinguished from all other members of *Agapostemon* by its long filamentous flagellum with the apical flagellomere flattened (Fig. 131).

#### DESCRIPTION

MALE (Figs. 77-78, 131, 154, 207)

General coloration of head and thorax metallic green, abdomen with black and yellow bands. **Head** (Figs. 77-78): (1) *Labrum* as in *A. texanus* but slightly more acute apically. (2) *Clypeus* with punctation as in *A. leunculus*, pubescence white to yellowish. (3) *Interocular area* above an-

tenal sockets very coarsely rugose or with dense contiguous punctures, coarsely rugose at level of antennal sockets, becoming moderately rugose below antennal sockets; pubescence white to yellowish. (4) *Vertex* with sculpturing as in *A. leunculus*; pubescence white to yellowish. (5) *Gena* with sculpturing as in *A. leunculus*; pubescence white to yellowish as in *A. leunculus* but denser and medially more coarsely branched and bent medially so as to cover the proboscis fossa. (6-7) *Malar area* and *mandible* as in *A. texanus*. (8) *Antenna* (Fig. 131) with apical flagellomere and distal  $\frac{2}{3}$  of subapical flagellomere dark brown to black, remainder of flagellum and pedicel brown above and yellow-amber below, scape amber with dark streak on distal  $\frac{2}{3}$  of upper surface. **Mesosoma:** pubescence moderately long, evenly distributed (except pronotum), and whitish to amber as in *A. leunculus*. (9) *Pronotum* as in *A. leunculus*. (10) *Mesoscutum* finely and contiguously punctate, sometimes finely rugose anteriorly and laterally. (11) *Mesoscutellum* with punctures separated by about  $\frac{1}{2}$  their diameters, slightly coarser than those of mesoscutum and becoming rugulose laterally. (12) *Metanotum* finely rugulose medially becoming shallowly rugose laterally. (13) *Mesepisternum* as in *A. nasutus*. (14) *Metepisternum* rugose with few weak horizontal carinulae. (15) *Propodeum* as in *A. leunculus* but with more prominent propodeal carina. (16) *Wing* as in *A. leunculus*. (17) *Tegula* as in *A. nasutus* but with reduced yellow area. (18) *Fore leg* as in *A. leunculus* but more slender; pubescence white to amber. (19) *Middle leg* very slender; coxa dark brown to black, remainder of leg yellow with brown-black on all but anterior surface of trochanter and with brown-black stripe on basal  $\frac{1}{2}$ - $\frac{2}{3}$  of posterior surface of tibia; pubescence white to amber. (20) *Hind leg* (Fig. 154) very slender, coxa metallic green, trochanter brown-black, remaining segments yellow with brown streak on posterior of femur and brown at base of tibia; pubescence white to amber. **Meta-soma:** (21-22) *Terga* and *sterna* as in *A. leunculus*. (23) *Genitalia* (Fig. 207) very similar to *A. leunculus* but penis valves broader and flatter, medial plate of gonostylus longer and narrower; and ventral lobe smaller and not notched.

#### **Agapostemon sapphirinus n. sp.**

The name of this species refers to the sapphire blue color of the female.

I have seen 15 specimens (14 ♂, 1 ♀) of this species. The female holotype, the allotype and the 13 male paratypes are all labeled, "Bahamas/Clarendtown/Long Isl. Febr//Utowana/Exp. 1934." All of the types are at the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

**DIAGNOSIS.** Both males and females may be distinguished from all other West Indian species, except *A. cyanens* and *A. ochromops*, by their milky to yellowish eyes and pterostigma. The male may be distinguished from

*A. cyaneus* by the pale amber to yellow on the underside of its pedicel, but cannot be reliably distinguished from *A. ochromops*. The female may be distinguished from *A. ochromops* by its dark purple metallic color and from *A. cyaneus* by its very coarsely carinate gena.

## DESCRIPTION

## MALE

General coloration of head and mesosoma bright metallic green to dark metallic green to blue, metasoma with black and yellow bands. **Head:** as in *A. viequesensis* but with eyes cream-colored, underside of flagellum yellow, pubescence of interocular area slightly yellow, and sculpturing very slightly coarser. **Mesosoma:** pubescence as in *A. viequesensis* but slightly yellowish laterally and slightly darker on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe more angular than in *A. viequesensis*. Carinulae on postero-lateral area larger and fewer in number than in *A. viequesensis*. (10-12) *Mesoscutum*, *mesoscutellum* and *metanotum* as in *A. viequesensis* but with very slightly coarser sculpturing. (13-15) *Mesepisternum*, *metepisternum* and *propodeum* as in *A. viequesensis* but with much coarser sculpturing. (16) *Wing* as in *A. viequesensis* but with yellow pigment on pterostigma and underside of larger veins. (17) *Tegula* as in *A. viequesensis* but with metallic tints less extensive. (18-20) *Fore*, *middle* and *hind legs* as in *A. viequesensis*. **Metasoma:** (21) *Terga* as in *A. viequesensis* but with metallic tints on some specimens (never as extensive as in *A. poeyi*), with dark bands almost black, and with yellow bands paler. Apex of pygidium nearly as acute as in *A. ochromops*. (22) *Sterna* as in *A. viequesensis* but often yellower basally and darker along apical margin. (23) *Genitalia* as in *A. poeyi* (cf. Figs. 186, 210).

## FEMALE

Female as in *A. poeyi* but deep metallic blue, with metallic tints on sterna less intense and less extensive, with indistinct brown to ferruginous bands on terga 1-4, with creamy pigment on pterostigma and underside of larger wing veins, and with eyes pale.

**Agapostemon semimelleus** Cockerell

*Agapostemon semimelleus* Cockerell 1900. **Lectotype** ♂, Carnegie Museum, Pittsburgh.  
*Halictus (Agapostemon) andensis* Vachal 1903 (**new synonymy**). Type ♀, Muséum National D'Histoire Naturelle, Paris.

? *Agapostemon castaneus* Schrottky 1902b. Type ♀? Departamento de Zoologia, São Paulo?  
Schrottky (1909b) tentatively synonymized the female of this species with *A. semimelleus*.  
Not having seen a type I cannot dispute his judgement.

? *Agapostemon coryliventris* Holmberg 1903. Type ♀.

? *Agapostemon multicolor* Holmberg 1903. Type ♂. According to J. S. Moure (pers. comm.) the types of most Holmberg species have been destroyed by dermestids. Therefore I am following Schrottky (1909b) in his synonymy of *A. coryliventris* and *A. multicolor* with

*A. semimelleus*. Although these nominal species may be synonyms of *A. chapadensis* they would still be junior synonyms.

I have seen the syntypes of *A. semimelleus* and have labeled the male as lectoholotype and the female as lectoallotype. Both specimens are from Chapada. I selected the male as lectoholotype because I am unable to distinguish the females of *A. semimelleus* and *A. chapadensis*, although the female lectoallotypes are easily distinguished.

**DISTRIBUTION.** This species is widespread in the *campos*, or tropical grasslands, of southern Brasil, of Paraguay and of northeastern Bolivia. It has also been collected at the heads of the Marañon and Ucayali Valleys in Peru, the heads of the Putamayo and Cauca Valleys in Colombia, and along the eastern slopes of the Andes in Bolivia and northern Argentina. It ranges from sea level in southeastern Brasil to 1,700 m in Bolivia. It has been collected during every month but May, but in the southern part of its range is found only during the summer months.

**DIAGNOSIS.** The male may be distinguished from most other South American species of *Agapostemon* by the acute lateral angle on its pronotum and lack of a "button" on its last visible sternum (6th). It may be distinguished from *A. chapadensis* by the shorter distal stylus of its genitalia (Figs. 173-174) and by the lesser amount of black on the posterior of its hind femur (Figs. 171-172).

The female cannot be distinguished from *A. chapadensis* (cf. VARIATION below) but it may be distinguished from other South American *Agapostemon* by the acute upturned flange on its anterior mesoscutal margin and lack of basal yellow bands on its metasomal terga.

**VARIATION.** When *A. semimelleus* and *A. chapadensis* were first described, the females were separated chiefly on the basis of metasomal color. Supposedly the female metasoma of *A. semimelleus* is honey-colored while that of *A. chapadensis* is black. However, I feel that this character is unreliable because I have seen specimens where the anterior of the metasoma was honey-colored while the posterior was black. I have also seen specimens with a dark brown metasoma.

Independent evidence leads me to believe that intra-specific variation masks interspecific differences between the females of these two species. The males of *A. semimelleus* are far more abundant and widespread than those of *A. chapadensis*. Unless one assumes that there are great disparities between the distributions and relative abundance of females and males, one must conclude that the metasoma of *A. semimelleus* females is frequently black. It is also possible that some females of *A. chapadensis* have brown or amber metasomas. At present there seems no solution to this problem. A similar problem exists with respect to the sculpturing of females of *A. texanus* and *A. angelicus*.



## DESCRIPTION

MALE (Figs. 123-124, 171, 174, 220)

General color of head and mesosoma bright metallic green, metasoma banded with black and yellow. **Head** (Figs. 123-124): with pale amber pubescence on interocular area and vertex, becoming creamy on gena. (1) *Labrum* opaque yellow with apical and lateral margins transparent amber. Two-thirds as long as wide, apex narrowly rounded, basal ridge broad. Small, shallow, scattered punctures on dorsal ridge. Fringed with stiff submarginal bristles apically. (2) *Clypeus* with large (sometimes very large) scattered punctures on yellow region, becoming contiguously punctate to rugose on upper margin. (3) *Interocular area* with small to moderately small, deep, contiguous punctures below ocelli, becoming shallower and medium-sized at level of antennal sockets and still shallower below antennae; supraclypeal protuberance with large, contiguous, moderately deep punctures. Pubescence between antennal sockets  $\frac{1}{2}$ - $\frac{2}{3}$  as long as scape, becoming shorter laterally, dorsally and ventrally and sub-tomentose ventro-laterally. (4) *Vertex* with deep contiguous punctures anteriorly and laterally, becoming shallower and slightly larger between ocelli and transversely carinate posteriorly. (5) *Gena* with parallel, subcontiguous, short carinae extending dorso-laterally from just behind smooth shiny area on antero-ventral margin. Pubescence postero-medially about as long as scape, becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* yellow, very short and with minute appressed hairs. (7) *Mandible* yellow with apical  $\frac{1}{3}$  ferruginous. (8) *Antenna* brown to brown-black above, scape yellow below and sometimes with yellow extending dorsally at base, pedicel and flagellum amber to yellow below. **Mesosoma**: pubescence creamy to yellowish, becoming golden to fulvus on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe acutely pointed, lateral angle projecting antero-laterally; with conspicuous sharp carina extending postero-ventrally from apex of lateral angle; with weak irregular rugae postero-laterally. Pubescence above lateral angle and posterior lobe golden to fulvus, yellowish to creamy below. (10) *Mesoscutum* with large conspicuous flange laterally on anterior margin extending antero-dorsally; punctures small, very deep and contiguous, becoming rugose antero-laterally. (11) *Mesoscutellum* with lateral and medial punctures like that of mesoscutum, becoming larger and less dense laterally; area on each side of mid-line shiny with scattered punctures. (12) *Metanotum* coarsely punctate to rugose medially, becoming moderately coarsely rugose laterally. (13) *Mesepisternum* coarsely rugose anteriorly, becoming moderately coarsely rugose posteriorly. (14) *Metepisternum* moderately finely rugose with horizontal rugae longer and slightly more prominent than other rugae. (15) *Propodeum* with propodeal carina strong and conspicuous; propodeal shield very coarsely and deeply punctate to very

coarsely rugose; dorsal area very deeply rugose anteriorly and medially, becoming moderately rugose to coarsely punctate laterally; lateral area with small, deep, subcontiguous punctures anteriorly and centrally, becoming coarsely rugose adjacent to propodeal carina. (16) *Wing* hyaline or nearly hyaline, veins dark brown. (17) *Tegula* pale to dark transparent amber with broad submarginal yellow band anteriorly (partially obscured by pubescence) and yellow to dark brown on proximal margin. (18) *Fore leg* entirely yellow, or yellow with brown postero-proximally on tibia and postero-dorsally on distal  $\frac{1}{3}$  of femur. (19) *Middle leg* yellow with brown postero-dorsally on tibia, usually postero-dorsally at apex of femur, and occasionally on coxa. (20) *Hind leg* (Fig. 171) yellow with upper  $\frac{1}{2}$  of coxa metallic, with trochanter brown basally and sometimes amber apically, with brown apically on femur and antero-dorsally on tibia. **Metasoma:** (21) *Terga* 2-6 amber to brown-black on posterior  $\frac{1}{2}$  and yellow on anterior  $\frac{1}{2}$  (often partially concealed by overlap); tergum 1 varying from pale amber with brown band on posterior margin to brown-black with lateral yellow spot antero-dorsally, but most commonly intermediate in condition with antero-dorsal yellow band separating dark brown anterior and posterior regions. Very conspicuously punctate with subcontiguous punctures largest on tergum 1, becoming progressively smaller on posterior terga. Pubescence golden to fulvus anteriorly on tergum 1, laterally on terga 1-7 and dorsally on terga 5-7; very short dorsally on terga 1-4, golden to fulvus on yellow bands and dark brown to brown-black on dark bands. (22) *Sterna* 2-6 yellow but with amber to brown band at posterior margin of sterna 2-5, narrow on sternum 2, becoming progressively wider on successive sterna 3-5; sternum 1 amber with metallic tints basally. Sternum 6 with low proximo-medial ridge. Pubescence limited to scattered, moderately long, fulvus to golden hairs on exposed areas. (23) *Genitalia* (Figs. 174, 220) with very short ventral lobes bearing apical brush of large stiff hairs. Distal stylus little longer than width of medial plate.

#### FEMALE (Figs. 129-130)

General coloration of head and mesosoma bright metallic green, metasoma honey-colored to black. **Head** (Figs. 129-130): bright metallic green; pubescence white below becoming pale yellow above; sculpturing as in *A. atrocaeruleus*. **Mesosoma:** bright metallic green, but with tegula, legs and wing venation amber to brown; pubescence yellow or amber above, becoming creamy below; sculpturing as in *A. atrocaeruleus* but dorsal and lateral propodeal rugae more irregular. **Metasoma:** honey-colored to black; pubescence creamy, very short and appressed dorsally, becoming moderately long and erect anteriorly, laterally and posteriorly, and with narrow band of white tomentum basally on terga 2-4; sculpturing as in *A. atrocaeruleus*.

**Agapostemon splendens** (Lepeletier)

*Halictus splendens* Lepeletier 1841. Type ♀, Muséum National D'Histoire Naturelle, Paris.  
*Agapostemon aeruginosus* Smith 1853. Type ♀, British Museum (Natural History).  
*Agapostemon splendens*. Robertson, 1897.

I have seen the type of *Halictus splendens*, which was loaned to me by Dr. S. Kelner-Pillault. The type of *A. aeruginosus* was examined by Cockrell, and more recently by Michener, and both believe it is conspecific with *A. splendens*.

**DISTRIBUTION** (Fig. 19). *Agapostemon splendens* is the most common species of *Agapostemon* in the southeastern United States and along the Gulf Coast. It is also common in the sandy areas of the Central States and Michigan. It is found as far south as Veracruz, Mexico, as far north as southern Saskatchewan, Canada, and as far west as south-central Utah. In Canada females have been collected in May, June, July and August; males in August and September. In Kansas females have been collected from April through October and males from July through October. In Florida both sexes have been collected every month of the year. While more common at elevations of less than 2,000 ft. (610 m), *A. splendens* has been collected as high as 6,600 ft. (2,012 m) in the Great Smoky Mountains National Park in Tennessee and 3,700 ft. (1,127 m) near Wray, Colorado.

**DIAGNOSIS.** The male may be distinguished from other species by its toothed hind femora, the grooved basal ridge on its basitarsus, the apical stylus on its gonostylus, and its brown wings. The female may be distinguished from other species by its metallic green metasomal terga, rounded lateral pronotal angle, punctate mesoscutum and brown wings.

**DESCRIPTION**

**MALE** (Figs. 71-72, 166, 179, 200)

General coloration of head and mesosoma bright metallic green, metasoma with black and yellow bands. **Head** (Figs. 71-72): pubescence white, yellowish on vertex. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with large, shallow, scattered punctures on lower  $\frac{1}{2}$ , becoming contiguous above. (3) *Interocular area* with deep, contiguous, medium punctures below ocelli, becoming rugose laterally and below; sculpturing of supraclypeal protuberance like that of adjacent clypeal area. (4) *Vertex* with deep, contiguous, medium punctures anteriorly, becoming rugose laterally, posteriorly and between ocelli. (5) *Gena* with short coarse carinae extending dorso-laterally from antero-ventral margin. (6) *Malar area* bright yellow, short. (7) *Mandible* bright yellow, pale ferruginous on apical  $\frac{1}{4}$ - $\frac{1}{3}$ . (8) *Antenna* black above with yellow sometimes present on basal  $\frac{1}{4}$ - $\frac{1}{3}$  of scape and present on apical flagellomere; scape yellow below, pedicel with yellow spot on underside, and underside of flagellum pale amber. **Mesosoma**: pubescence

yellow to amber on mesonotum and metanotum, white elsewhere. (9) *Pronotum* with lateral angle rounded and rugose above; postero-lateral area with large vertical carina just anterior to several irregular horizontal carinae. (10) *Mesoscutum* with coarse contiguous punctures becoming rugose antero-laterally. (11) *Mesoscutellum* with coarse contiguous punctures anteriorly, becoming rugose posteriorly. (12) *Metanotum* rugose. (13) *Mesepisternum* coarsely rugose anteriorly, only slightly less coarse posteriorly. (14) *Metepisternum* with very coarse irregular horizontal carinae or coarsely rugose. (15) *Propodeum* with propodeal carinae distinct; propodeal shield coarsely rugose; very coarsely rugose postero-laterally, becoming rugulose antero-laterally; coarsely rugose dorsally with triangular medial area depressed, rugulose. (16) *Wing* yellowish brown, conspicuously darker on distal  $\frac{1}{4}$ - $\frac{1}{3}$ ; veins and pterostigma amber to brown with radius conspicuously darker than other veins. (17) *Tegula* pale transparent amber with green tints antero-basally and short transverse yellow band on anterior area curving rearward and almost reaching distal margin. (18) *Fore leg* yellow with coxa metallic green and trochanter with amber tints dorsally. (19) *Middle leg* yellow with metallic tints on coxa and dark brown streak centrally on postero-dorsal surface of tibia. (20) *Hind leg* (Fig. 166) yellow; coxa and trochanter metallic green; femur with brown on apical  $\frac{1}{4}$ - $\frac{1}{3}$  of anterior, dorsal and posterior surfaces; tibia with brown posteriorly on distal  $\frac{1}{2}$ , antero-dorsally on proximal  $\frac{1}{2}$ , basally, and apically on anterior and dorsal surfaces; basitarsus with amber on grooved portion of basal ridge and on apical groove. **Metasoma:** (21) *Terga* brown to brown-black with yellow bands on basal halves of terga 2-6, and with central yellow band on tergum 1; anterior face of tergum 1 pale amber to brown. Pubescence short, minute and dense on dorsal areas, brown-black on brown surfaces and white on yellow or amber surfaces; pubescence longer on anterior surface of tergum 1 and ventro-laterally on terga 5-7. (22) *Sterna* brown apically with varying amounts of yellow basally (always some yellow present); low, transverse, subapical ridge on sternum 4 (and sometimes 3) largest laterally; long, white, scattered pubescence on exposed areas. (23) *Genitalia* (Figs. 179, 200) with ventral lobes large and fringed with hairs distally.

#### FEMALE (Figs. 69-70)

General coloration of head, mesosoma and metasoma bright metallic green to blue-green. **Head** (Figs. 69-70): pubescence white to yellowish on clypeus and interocular area, becoming yellow to amber on vertex; white on gena. (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with large scattered punctures below, becoming subcontiguous on upper  $\frac{2}{3}$ . (3) *Interocular area* rugose with coarse contiguous punctures below ocelli; supraclypeal protuberance with coarse punctures and faint horizontal carinae. (4) *Vertex*

with coarse contiguous punctures anteriorly, becoming rugulose laterally and between ocelli to rugose posteriorly. (5) *Gena* with coarse carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* very short, dark brown. (7) *Mandible* yellowish to amber with apical  $\frac{1}{3}$ - $\frac{1}{2}$  ferruginous. (8) *Antenna* dark brown to brown-black with underside of flagellum slightly paler. **Mesosoma:** pubescence white, becoming yellowish on mesonotum and metanotum. (9) *Pronotum* with lateral angle rounded; dorsal aspect of lateral angle and posterior lobe shallowly rugose; postero-lateral area with several carinae extending postero-ventrally and antero-dorsally. (10) *Mesoscutum* with coarse, deep, contiguous punctures becoming rugose antero-laterally (punctures sometimes appearing to be of two sizes as in *A. texanus* but surface never as shiny). (11) *Mesoscutellum* with large scattered punctures and with much smaller contiguous punctures; central region just lateral to mid-line often shiny and devoid, or nearly devoid, of small punctures. (12) *Metanotum* rugose to rugulose. (13) *Mesepisternum* coarsely rugose. (14) *Metepisternum* rugose or with very irregular horizontal carinae. (15) *Propodeum* with strong propodeal carina; propodeal shield coarsely rugose or with irregular carinae extending dorso-laterally from medial groove. (16) *Wing* as in  $\delta$ . (17) *Tegula* as in  $\delta$  but slightly darker amber. (18) *Fore leg* dark brown to brown-black; coxa metallic green; femur with pale yellow anteriorly, dorsally and posteriorly at apex; tibia with basal yellow spot dorsally and pale brown on anterior surface; tarsus pale brown; pubescence white to amber. (19) *Middle leg* like fore leg but with coxa largely brown and with pubescence brown-black dorsally on tibia and basitarsus. (20) *Hind leg* brown to brown-black, coxa with metallic tints dorsally; pubescence white to amber, becoming brown-black dorsally on tibia and basitarsus. **Metasoma:** (21) *Terga* bright metallic green to blue dorsally, becoming brown ventro-laterally and brown basally on tergum 1. Pubescence white, becoming black on terga 5-6; long ventro-laterally on anterior surface of tergum 1 and dorsally on terga 5-6; terga 2-5 with basal bands of white tomentum. (22) *Sterna* brown to brown-black with long white hairs scattered on exposed areas.

#### *Agapostemon swainsonae* Cockerell

*Agapostemon swainsonae* Cockerell 1910b. Type  $\delta$ , British Museum (Natural History).

The type has been examined by C. D. Michener. Its shiny mesoscutum leaves no doubt as to its identity.

The female is recognized here for the first time.

**DISTRIBUTION.** This species is apparently limited to the island of Jamaica. I have seen specimens from the following localities: Yardley Chase, Santa Cruz Mtns., St. Elizabeth, 1,500 ft., (2  $\delta$ , Oct.); Mandeville (1  $\delta$ ); Portland (2  $\varphi$ ); Christina, 3,000 ft. (1  $\varphi$ , July); Hanover, Great River District (1  $\varphi$ , Jan.); Baron Hill, Trelawny (1  $\varphi$ , June).



**DIAGNOSIS.** The male is easily distinguished from all other West Indian species by its very shiny, weakly sculptured mesoscutum. The female has not been recognized previously owing to its similarity to *A. viridulus*. It may be distinguished from all but *A. viridulus* and *A. hispaniolicus* by its bright metallic green head and mesosoma and black metasoma; from *A. hispaniolicus* by its more rugose interocular area; and from *A. viridulus* by the lack of metallic green tints at the base of its mandibles and by the lighter color of its mandibles.

#### DESCRIPTION

MALE (Figs. 113-114, 147, 209)

General coloration of head and mesosoma bright metallic green and shiny, metasoma amber to yellowish brown. **Head** (Figs. 113-114): pubescence yellowish on clypeus, interocular area and vertex; white on gena. (1) *Labrum* as in *A. viridulus* but yellow to white on basal  $\frac{1}{2}$  and pale transparent amber on apical  $\frac{1}{2}$ . (2) *Clypeus* yellow to white below and nearly as elongate as in *A. viridulus*; punctures scattered and with numerous transverse rugulae on metallic area; pubescence short and sparse. (3) *Interocular area* shallowly rugulose around antennal sockets, becoming finely and shallowly punctate dorsally and ventro-laterally; supra-clypeal protuberance with punctures and transverse rugulae similar to those on clypeus; pubescence as in *A. viridulus*. (4) *Vertex* with very shallow, small, scattered punctures anteriorly and laterally, becoming finely rugose posteriorly; area between ocelli almost impunctate; pubescence as in *A. viridulus*. (5) *Gena* as in *A. viridulus* but with rugae weaker and more numerous. (6) *Malar area* as in *A. viridulus* but slightly shorter. (7) *Mandible* as in *A. viridulus*. (8) *Antenna* medium brown above, scape yellow to white below, flagellum amber to creamy below, underside of pedicel slightly darker than underside of flagellum. **Mesosoma**: pubescence creamy to yellowish on mesonotum and metanotum, white laterally, ventrally, and on propodeum. (9) *Pro-notum* as in *A. viridulus*. (10) *Mesoscutum* very shiny (more so than in any other species of *Agapostemon*); very shallow, small punctures separated by their diameters. (11) *Mesoscutellum* very shiny with very small, shallow, widely scattered punctures. (12) *Metanotum* shiny, with minute, shallow, scattered punctures medially, becoming finely and irregularly rugulose laterally. (13) *Mesepisternum* as in *A. viridulus* but sculpturing finer and shallower. (14-15) *Metepisternum* and *propodeum* as in *A. viridulus* but with slightly shallower sculpturing. (16) *Wing* as in *A. viridulus* (1 ♂ with white pigment on underside of pterostigma and veins). (17) *Tegula* pale transparent, metallic tints absent or very faint, and yellow to creamy transverse lunule truncate basally and almost reaching distal margin. (18-19) *Fore* and *middle legs* yellowish amber with strong metallic tints on coxae; pubescence white on coxae, amber on other segments. (20) *Hind leg* (Fig. 147) as in

*A. viridulus* but with brown areas much paler brown (or amber). **Metasoma:** (21) *Terga* amber with indistinct, slightly darker bands centrally. Pubescence moderately long, scattered, white ventro-laterally and on anterior surface of tergum 1; very short, inconspicuous white tomentum basally on terga 2-6 (usually hidden by overlapping terga); inconspicuous, dense, short, prostrate hairs dorsally on terga 1-4; long fuliginous hairs dorsally on terga 4-7. (22) *Sterna* amber to yellowish with long, white, scattered hairs on exposed areas. (23) *Genitalia* as in *A. viridulus* but with only about  $\frac{1}{2}$  as many lateral grooves on gonocoxa (Fig. 209).

#### FEMALE (Figs. 35-36)

As described for *A. viridulus* but slightly bluer on head and metasoma; with finer sculpturing; with lower portion of clypeus, basal  $\frac{2}{3}$  of mandible, and labrum amber; and without metallic tints basally on mandible.

#### *Agapostemon texanus* Cresson

- Agapostemon texanus* Cresson 1872. Type ♀, Academy of Natural Sciences, Philadelphia.  
*Agapostemon texanus subtilior* Cockerell 1898. Type ♀ (?), whereabouts unknown; neotype ♀, University of Colorado Museum, Boulder.  
*Agapostemon borealis* Crawford 1901. Type ♀, Academy of Natural Sciences, Philadelphia.  
*Agapostemon californicus* Crawford 1901. Lectotype ♀, U.S. National Museum.  
*Halictus (Agapostemon) brachycerus* Vachal 1903 (new synonymy). Type ♂, Muséum National D'Histoire Naturelle, Paris.  
*Agapostemon texanus iowensis* Cockerell 1910c (new synonymy). Type ♀, U.S. National Museum.  
*Agapostemon proscriptus* Cockerell 1912b (new synonymy). Type ♀, U.S. National Museum.  
*Agapostemon joseanus* Friese 1916 (new synonymy). Type ♀, Zoologisches Museum, Humboldt Universität, Berlin.  
*Agapostemon sulfuripes* Friese 1916 (new synonymy). Type ♂, whereabouts unknown.  
*Agapostemon cyanozonus* Cockerell 1924 (new synonymy). Type ♂, California Academy of Sciences, San Francisco.  
*Agapostemon proscriptellus* Cockerell 1924 (new synonymy). Type ♀, California Academy of Sciences, San Francisco.  
*Agapostemon texanus vandykei* Cockerell 1925. Type ♀, California Academy of Sciences, San Francisco.  
*Agapostemon californicus psammobius* Cockerell 1937b (new synonymy). Type ♂, California Academy of Sciences, San Francisco.  
*Agapostemon angelicus idahoensis* Michener 1937 (new synonymy). Type ♀, Snow Entomological Museum, University of Kansas, Lawrence.  
*Agapostemon californicus clementinus* Cockerell 1939 (new synonymy). Type ♀, University of Colorado Museum, Boulder.

I have examined the types of all the nominal species and subspecies listed above except *A. texanus subtilior* and *A. sulfuripes*. As I find the females of *A. texanus* are indistinguishable from those of *A. angelicus*, female synonymies are based upon the distributions of the males (see map, Fig. 20). The type localities are as follows: *A. texanus*, Texas; *A. borealis*, Vancouver I., Canada; *A. californicus*, Pacific Grove, California; *H. (A.) brachycerus*, Guatemala; *A. texanus iowensis*, Ames, Iowa; *A. proscriptus*, Guatemala City, Guatemala; *A. joseanus*, San José, Costa Rica; *A. cyanozonus*,

Guaymas, Mexico; *A. proscriptellus*, Guaymas, Mexico; *A. texanus vandykei*, Yosemite Valley, California; *A. californicus psammobius*, San Miguel I., California; *A. angelicus idahoensis*, Challis, Idaho; *A. californicus clemensinus*, San Clemente I., California.

The type of *Agapostemon texanus subtilior* Cockerell has not been identified by subsequent revisors and it is possible that Cockerell failed to designate the type series with appropriate labels. I have designated a female in the University of Colorado Museum as the **neotype**. This specimen is probably from the series described by Cockerell as it bears a label identical to that of some of the females mentioned by Cockerell, "Pasco, Wash/5 25 96."

I have not been able to examine a type of *Agapostemon sulfuripes* Friese, but the description is good and its identity with *A. texanus* is obvious.

**DISTRIBUTION** (Fig. 20). The range is greater than that of any other species in the genus. It may be found from southern Canada ( $52^{\circ}$  N) to central Costa Rica ( $10^{\circ}$  N) and from Cape Cod, Massachusetts ( $70^{\circ}$  W) to Vancouver Island, Canada ( $125^{\circ}$  W). *Agapostemon texanus* is most abundant on the western coast of the United States; fairly abundant in the United States west of the Mississippi River, except for the arid Southwest; uncommon in the arid Southwest, the United States east of the Mississippi River, Mexico, and Central America. This species occurs from sea level on the Atlantic, Gulf and Pacific coasts to about 8,000 ft. (2,438 m) in the Sierra Nevada of California. At the northern limits of its range (British Columbia) females of *A. texanus* have been collected from May through September and males from July through October; in Kansas females (including those of *A. angelicus*) have been collected from April through November and males in April (very rare) and from June through October; in Arizona females (including those of *A. angelicus*) have been collected from February through November and males in July and August; and in Mexico females (including those of *A. angelicus*) have been collected from February through October and in December, and males from April and June through September.

From its geographic distribution it appears that *A. texanus* is able to live under a wide variety of climatic conditions and in 70 of the 116 plant communities (see Appendix A) occurring in the United States (Küchler, 1964). Considering the lack of apparent climatic, biotic or edaphic factors correlated with its distribution, I find the distribution of *A. texanus* inexplicable. In a species as widespread and heterogeneous as this (cf. discussion of variation), factors which limit its distribution in one area may be relatively unimportant in another.

**DIAGNOSIS.** The male may be distinguished from males of many other species by its toothed hind femora, the apical stylus on its gonostylus, and

the lack of a low medial ridge on the apical  $\frac{1}{2}$  of its last visible sternum; from *A. splendens* by the lack of a grooved basal ridge on its hind basitarsus; and from *A. angelicus* by the apical stylus of its gonostylus (Figs. 180-181) and usually by the presence of a black stripe anteriorly on its hind tibia (if absent, then also lacking black stripe on posterior surface of hind tibia). The female may be distinguished from most other species by its bright metallic green to blue metasomal terga, its almost hyaline wings, and its two distinct sizes of mesoscutal punctures. I have not distinguished the females of *A. texanus* from those of *A. angelicus* except where they occur well outside the distribution of *A. angelicus* males (Fig. 20).

VARIATION. The amount of variation is reflected by the length of the synonymy, which consists of 15 names. Although specimens from different parts of the range differ in color, pattern and sculpturing, the male genitalia are all alike and there are intergrades among the other characters. Therefore, I conclude that the described variants all belong to one species. *A. angelicus* is superficially more similar to the typical form of *A. texanus* than is *A. texanus vandykei*. However, I regard *A. angelicus* as a separate species because: the male genitalia—which provide excellent specific characters in many other species of *Agapostemon*—are different from those of *A. texanus* (Figs. 180-181); there are no intergrades between the two species with regard to certain color patterns; the two are sympatric.

The variation within *A. texanus* falls into three major categories. These are the area and density of melanic pigmentation, the amount and hue of structural (metallic) coloration, and the sculpturing.

Melanic pigmentation is best seen in males, as it is obscured or replaced by the structural colors predominant in females. The melanic pigmentation varies in density from pale amber to brown-black, and varies both within and among localities. It was expected that there might be concordance of variation in the size of melanic maculations on the appendages. However, specimens from San Clemente Island, California have no yellow (0%) on either the fore coxa or lower  $\frac{1}{2}$  of the scape; whereas specimens from Jalisco, Mexico, have little (10%) yellow on the fore coxa but much (95%) on the lower  $\frac{1}{2}$  of the scape. Nor could precipitation, temperature or other ecological factors account for the similarity between, for example, populations from New Hampshire and San Clemente Island, California (underside of scape 100% black) or between Saskatchewan, Canada, and Missouri (underside of scape 100% yellow).

There are considerable differences of color pattern among various populations (Table 1). However, they can all be explained in terms of an increase or decrease in the amount (area) of melanic pigmentation. For example, although the black stripe on the posterior surface of the hind femur is absent in some populations and present in others, it can be shown that this

TABLE 1. Intraspecific variation among selected populations of *A. texanus*. Numbers represent range and modal class (*italics*). Structural colors from Ridgway (1912).

CHARACTERS	POPULATIONS						
	Mexico Jalisco	California San Clemente I.	California Trinity Co.	Washington Seattle	Canada Saskatchewan	New Hampshire	Missouri
Scape (% lower ½ dark) ♂ ♂	40-5-0	100	90-20-10	95-20-0	0	100-95	0
Fore coxa ♂ ♂ (% area dark)	100-90	100	90-20	70-50-40	40-20-0	100-95	60-50-40
Anterior stripe on hind femur of ♂ ♂ (% of femoral length)	20-0	95-80-70	30-25-20	40-35-10	30-20-0	95-80-50	90-80-45
Posterior stripe on hind femur of ♂ ♂ (% of femoral length)	20-0	50-40	10-5	50-5-0	0	100-40-30	100-70-50
Mesoscutum ♀ ♀ (Punctuation)	Dull	Dull	Dull	Shiny	Shiny	Intermediate	Intermediate
Mesoscutum ♀ ♀ (Color of pubescence)	Yellow	Testaceous	Testaceous	Testaceous	White	Testaceous	Yellow
Structural colors ♀ ♀ (Ridgway, 1912)	Green b Cendre	G-BBk Paris Blue	G-Yi Javel Green	BB-Gi Ethyl Green	GB-Gi Viridian Green	Green b Cendre	GB-G Vivid Green



stripe is absent only in those populations in which the anterior stripe is reduced or absent, and that the reverse is never true. Every specimen in which the posterior hind femoral stripe is present and the anterior stripe absent proves, upon examination of the genitalia, to be *A. angelicus* rather than *A. texanus*. Therefore, although differences of color pattern do exist among individuals and populations, they are a result of the amount of melanic pigmentation.

One of the most obvious variables is the hue of the structural (metallic) coloration. It is usually pure green, but in some populations is yellowish or blue. The extremes of the yellowish and blue forms are so distinctive that they may be distinguished at a distance of several feet. The yellowish form (*A. vandykei*) occurs in the Sierra Nevada of California and in the Coast Ranges north of San Francisco. Limited to montane areas, it is not found along the coast or in the Central Valley. This form has strong brassy yellow overtones which are most striking in the Sierra Nevada south of Yosemite National Park and in the southern portion of the Coast Ranges north of San Francisco. The yellow cast becomes less pronounced further north to the point where it is replaced by the pure green of *A. texanus texanus* along the California-Oregon border.

The blue form of *A. texanus* (*A. californicus*) is found on the coast of California south of Cape Mendocino, in the Central Valley, and on the islands off the coast of southern California. It occurs only at low elevations and is not sympatric with the yellow form. It is most easily recognized by the bluish (rather than green) cast of the metallic coloration, which is particularly pronounced in the mesoscutum of males. This hue is most intense in the southern portion of the range, most notably on San Clemente Island (*A. californicus clementinus*), where it is a very dark violaceous blue. However, it becomes greener further north to the point where, along the California-Oregon border, it is replaced by the pure green of *A. texanus texanus*.

It is interesting that there do not seem to be intermediates between the yellow and blue forms in the southern portions of their ranges. It would be logical to regard them as separate taxa were it not for the green intermediate forms to the north. Although the origins of this geographic distribution of color forms are doubtless environmental, the populations must be relatively homogeneous genetically for this character because annual or local environmental fluctuations have no apparent effect upon the colors of the populations.

Variation in sculpturing is best seen on the mesosoma of females. The punctures on the mesoscutum range from deep and contiguous (Fig. 24) to relatively shallow and far apart (Fig. 23). The former condition produces a rough and dull appearance, the latter a relatively smooth and shiny surface.

There are slight geographical variations in this character (Table 1), but the variation within a given locality is considerable. Although the rugae on the propodeum all follow the same general pattern, they vary considerably in number, coarseness, angle of divergence and number of interconnections (Figs. 25-26). This variability is so great within a locality that it is impossible to discern a significant difference among localities. In fact it is so great as to invalidate the contention of Sandhouse (1936) and her predecessors that *A. texanus* females may be distinguished from those of *A. angelicus* by propodeal sculpturing.

#### DESCRIPTION

##### MALE (Figs. 75-76, 165, 180, 201)

General coloration of head and mesosoma bright metallic green to blue, metasoma with black and yellow bands. **Head** (Figs. 75-76): (1) *Labrum* opaque lemon yellow with transparent pale amber margins (distal  $\frac{2}{3}$  amber on specimens from San Clemente I., California). Nearly as wide as long; distal margin rounded; and large transverse ridge on basal  $\frac{1}{3}$  with very slight medial depression. Punctures on crown of basal ridge shallow and separated by 2-3 times their diameters; submarginal punctures large and shallow medially, becoming smaller laterally and disappearing just anterior to basal ridge. Pubescence on crown of basal ridge minute, simple and erect; simple hairs in submarginal punctures about three times as long as puncture is wide and deflected distally. (2) *Clypeus* with coarse punctures contiguous at upper margin, becoming subcontiguous at lower margin and becoming smaller and shallower laterally; pubescence white, dense and about  $\frac{2}{5}$  length of clypeus medially, decreasing to  $\frac{1}{5}$  length of clypeus and loosely appressed at lateral margin. (3) *Interocular area* with small, deep, contiguous punctures below ocelli, becoming coarser laterally and moderately deeply rugulose above antennal sockets and shallowly rugulose ventro-laterally; supraclypeal protuberance coarsely punctate to shallowly rugose; pubescence white, erect,  $\frac{1}{2}$  as long as scape medially, becoming  $\frac{1}{4}$  as long laterally. (4) *Vertex* with small, deep, contiguous punctures anteriorly, becoming shallower laterally; weakly rugose posteriorly, becoming weakly rugulose to weakly punctate between ocelli; pubescence white,  $\frac{3}{4}$  as long as distance between lateral ocelli medially, decreasing to  $\frac{1}{2}$  as long as distance between lateral ocelli laterally. (5) *Gena* with hypostomal carina about 2.5 times as long as width of proboscis fossa; short parallel carinulae extending postero-dorsally from antero-ventral margin; pubescence white, ranging in length from  $\frac{2}{5}$  as long as hypostomal carina centrally to  $\frac{1}{5}$  as long laterally and dorsally. (6) *Malar area* yellow to amber; very short; pubescence short, white, appressed. (7) *Mandible* opaque lemon yellow with distal  $\frac{1}{3}$  ferruginous; punctures few, shallow and scattered thinly over basal

$\frac{1}{2}$ ; pubescence scant with small patch of short white hairs on base of mandible. Row of approximately eight evenly spaced amber hairs along lower margin of basal  $\frac{2}{3}$  of mandible, with proximal hairs nearly twice as long as distal hairs. (8) *Antenna* brown to brown-black above with pale amber or yellow on apical  $\frac{1}{2}$  of apical flagellomere; flagellum pale amber below; scape and pedicel yellow to black below (see remarks on VARIATION). **Mesosoma:** pubescence white, becoming creamy to golden on mesonotum and metanotum; metallic coloration brassy green to blue. (9) *Pronotum* with lateral angle and posterior lobe slightly angular. Weak carina extending postero-ventrally from lateral angle; low carina extending postero-ventrally from center of lateral portion; weak horizontal carinulae near postero-lateral margin; long pubescence above lateral angle and posterior lobe and very fine white tomentum on postero-lateral area. (10) *Mesoscutum* with numerous small, dense, deep, contiguous punctures becoming rugose antero-laterally. (11) *Mesoscutellum* with punctuation like that of mesoscutum but shallower, less dense, and often with shiny lateral area; pubescence like that of mesoscutum. (12) *Metanotum* coarsely punctate to rugulose; pubescence like that of mesoscutum. (13) *Mesepisternum* coarsely rugose anteriorly and only slightly less coarsely rugose posteriorly; pubescence long. (14) *Metepisternum* coarsely rugose, sometimes with horizontal rugae more prominent than others; pubescence long. (15) *Propodeum* with propodeal carina moderately weak to weak; propodeal shield moderately coarsely to moderately finely rugose; dorsal area moderately coarsely rugose medially and anteriorly, becoming finely rugose to finely rugulose postero-laterally; lateral area moderately finely rugose posteriorly, becoming punctate anteriorly. Pubescence very short dorsally, moderately long laterally and posteriorly. (16) *Wing* nearly hyaline, with pterostigma and all veins but radius amber; radius dark brown. (17) *Tegula* dark to very pale transparent amber, with large pale yellow lunulate maculation parallel to—but separated from— anterior margin, with metallic tints on basal margin, and with short pale yellow band on posterior margin. (18) *Fore leg* with coxa metallic green; trochanter yellow to brown-black; femur entirely yellow to yellow with dark brown on all but distal portion of posterior surface; tibia entirely yellow to yellow with dark brown on all but distal  $\frac{1}{3}$  of ventral surface and short brown stripe sub-basally on dorsal surface; tarsus yellow. Pubescence white, becoming pale amber on tarsus. (19) *Middle leg* with coxa brown-black tinted with metallic green; trochanter yellow with brown spot basally on posterior surface to entirely brown-black; femur entirely yellow to yellow with brown-black stripe broadest basally and narrowest distally extending from base to apex on posterior surface; tibia yellow with dark brown sub-basal stripe on basal  $\frac{1}{2}$  of dorsal surface to yellow with brown-black sub-basal stripe on basal  $\frac{2}{3}$  of dorsal surface and brown-black

stripe entire length of ventral surface; tarsus yellow. Pubescence similar to that on fore leg. (20) *Hind leg* (Fig. 165) with coxa bright metallic green; trochanter brown-black with metallic tints to yellow with dark brown basally; femur yellow with large brown apical spot postero-dorsally and sometimes with basal brown spot posteriorly; tibia yellow with small brown-black area at base and usually with apical streak of brown to brown-black on posterior surface and sub-basal streak of brown to brown-black antero-dorsally (posterior streak or both posterior and antero-dorsal streak may be absent); tarsus yellow. Basal ridge on basitarsus low and inconspicuous. Pubescence white, usually pale amber posteriorly on tarsus. **Metasoma:** (21) *Terga* black with yellow bands on basal halves of terga 2-5 and centrally on tergum 1; ventro-lateral margins of terga 1-6 transparent amber; metallic tints apically on terga 4-5, pygidium amber to yellow. Pubescence dorsally on terga 1-4 very short and inconspicuous, pale on yellow band, dark on brown-black bands; moderately long and white anteriorly on tergum 1, laterally on terga 3-5, and dorsally and laterally on terga 5-7. (22) *Sterna* yellow with brown band apically on sterna 2-5 (narrow on sternum 2 but occupying most of sternum 5); sternum 6 brown to yellow with brown band basally; sternum 1 yellow to amber, with metallic tints basally; sternum 4 with low, transverse ridge reaching distal margin laterally and usually with faint metallic spot medially. Moderately long, scattered, white hairs on exposed areas and with 2-4 large stout bristles disto-laterally on sternum 4. (23) *Genitalia* (Figs. 180, 201) with apical stylus, medial plate and basal stylus present; ventral lobe moderately large, fringed with short hairs distally.

#### FEMALE (Figs. 21-26, 67-68)

General coloration bright metallic green to blue or brassy. **Head** (Figs. 21-22, 67-68). (1) *Labrum* dark amber to ferruginous. Basal ridge prominent, proximal face sloping gently toward proximal margin, distal face sharply declivous, and apex of ridge with deep punctures; distal portion narrow, abruptly rounded at apex; conspicuous median keel on antero-distal portion, continued basally almost to basal ridge; anterior margin of keel flattened and slightly flared laterally; single row of dark amber, wide, flat, stiff bristles curving anteriorly at their apices and forming fimbria on antero-lateral margins of labrum. (2) *Clypeus* brown-black below, becoming green above; large, scattered, deep punctures below, becoming slightly smaller and subcontiguous above; pubescence creamy to amber with single row of amber bristles curving downwards from just above lower margin of clypeus. (3) *Interocular area* with deep, moderate sized, contiguous punctures below ocelli becoming rugose laterally and below; supraclypeal protuberance with moderate sized, scattered punctures between short transverse rugae. (4)

*Vertex* with deep, small to moderate sized, contiguous punctures anteriorly, becoming smaller and shallower laterally; rugulose posteriorly and between ocelli; pubescence creamy to amber. (5) *Gena* (Fig. 22) with regular, moderately coarse carinae extending postero-dorsally from antero-ventral margin; pubescence white and long. (6) *Malar area* amber to brown-black; very short; pubescence very short, sparse, white and tomentose. (7) *Mandible* yellow to pale amber with apical  $\frac{1}{3}$ - $\frac{1}{2}$  ferruginous; moderately long, white, scattered pubescence at base and single row of moderately long amber pubescence on lower margin. (8) *Antenna* dark brown to brown-black with underside of flagellum amber. **Mesosoma:** pubescence white, becoming creamy to amber on mesonotum and metanotum. (9) *Pronotum* as in  $\delta$  but with lateral angle and posterior lobe slightly more angular. (10) *Mesoscutum* (Figs. 23-24) with medium sized, moderately deep punctures separated by 2-3 times their diameters and interspersed with more numerous smaller and shallower contiguous to subcontiguous punctures; rugose antero-laterally (see discussion of VARIATION); pubescence moderately long. (11) *Mesoscutellum* with punctation like that of mesoscutum but small punctures smaller, more numerous and shallower; often shinier than mesoscutum; pubescence moderately long. (12) *Metanotum* finely and shallowly rugulose; pubescence moderately long. (13) *Mesepisternum* with coarse rugae anteriorly, becoming slightly less coarse posteriorly; pubescence moderately long. (14) *Metepisternum* with coarse, interconnected, horizontal carinae; pubescence moderately long. (15) *Propodeum* (Figs. 25-26) with prominent propodeal carina; propodeal shield weakly rugose with stronger rugae extending dorso-laterally from medial groove; dorsal area with weak, irregular, interconnected rugae extending posteriorly from anterior margin, becoming moderately finely rugose postero-laterally; lateral area with contiguous, horizontal carinulae and scattered small punctures; pubescence short dorsally, moderately long laterally and posteriorly. (16) *Wing* as in  $\delta$ . (17) *Tegula* as in  $\delta$  but slightly darker amber. (18) *Fore leg* with coxa dark brown to brown-black and tinted with metallic green; trochanter dark brown to brown-black, often with narrow, inconspicuous, yellow band apically on posterior surface; femur brown to brown-black, with apical yellow band; tibia brown-black, with amber to yellow anteriorly; tarsus brown-black to pale amber; pubescence creamy on coxa, becoming amber on tarsus. (19) *Middle leg* similar in color to fore leg but with pubescence fuliginous dorsally on distal portion of tibia and amber ventrally on femur and tibia. (20) *Hind leg* with coxa dark brown to brown-black with strong metallic green tints dorsally; trochanter brown to brown-black; femur, tibia and tarsus brown-black to pale amber; pubescence creamy on coxa, trochanter and femur, becoming amber on tibia and tarsus and dark fuliginous to black on dorsal surface of tibia (darkest basally). **Metasoma:** (21) *Terga*



metallic green to blue or brassy; white bands of pruinose pubescence covering basal  $\frac{1}{3}$  of terga 1-4 and white, very short, simple hairs covering dorsal  $\frac{2}{3}$  of terga 1-4; terga 5-6 with long, dark brown to black pubescence. (22) *Sterna* brown to brown-black with metallic tints basally on sternum 1; long, creamy, scattered hairs on exposed areas.

### *Agapostemon tyleri* Cockerell

*Agapostemon tyleri* Cockerell 1917a. Type ♀, U.S. National Museum.

*Agapostemon martini* Cockerell 1927, ♀ only, (new synonymy). Type ♀, California Academy of Sciences.

I have examined the holotypes of *Agapostemon tyleri* and *A. martini* and find them conspecific. Contrary to the opinion of Sandhouse (1936) I do not find the type of *A. tyleri* conspecific with that of *A. coloradensis* Crawford (cf. DIAGNOSIS). Cockerell correctly associated the sexes of *A. tyleri* but incorrectly associated the male of *A. cockerelli* with the female of *A. martini*. The male paratypes of *A. martini* are misidentified and belong to *Agapostemon cockerelli* Crawford.

DISTRIBUTION (Fig. 27). *Agapostemon tyleri* occurs in the desert Southwest and in arid parts of Mexico. I have seen specimens from as far north as Jerome, Arizona; as far south as Tehuacan, Puebla, Mexico; as far east as the Gulf Coast in Tamaulipas, Mexico; and as far west as Prescott, Arizona. It ranges from sea level in Tamaulipas, Mexico, to 8,200 ft. (2,499 m) at Pachuca, Hidalgo, Mexico. Throughout most of its range it occurs at altitudes of over 4,000 ft. (1,219 m) on the central plateau. In the United States males have been collected from February through April, June through September, and November; and females in April and May, July through September, and November. In Mexico males have been collected in February, May through September, and November; and females from June through September, and December.

DIAGNOSIS. The male may be distinguished from all North American species except *A. coloradinus* by the lack of yellow maculations on its dark brown to black metasomal sterna; from *A. coloradinus* by its smaller size, by the black streak extending the entire length of the posterior surface of its hind tibia (Figs. 159-160), and by its broader penis valve, which lacks conspicuous hairs on its dorsal crest (Figs. 226-227). The female may be distinguished from many other species occurring north of Mexico by its black metasoma and by the lack of yellow on its clypeus; from *A. virescens* by its finer genal carinulae (2-3 per 0.25 mm in *A. virescens* and 5-6 per 0.25 mm in *A. tyleri*, cf. Figs. 28-29); and from *A. coloradinus* by its colorless wings, darker tegulae, and shinier supraclypeal protuberance. This species is very close to *A. coloradinus*.

## DESCRIPTION

## MALE (Figs. 95-96, 159, 184, 198, 227)

General coloration of head and mesosoma bright metallic blue-green to blue, metasoma with black and pale yellow to creamy bands. **Head** (Figs. 95-96): pubescence snowy white. (1) *Labrum* as in *A. texanus* but more rounded at apex. (2) *Clypeus* as in *A. virescens* but punctures shallower and pubescence more dense. (3) *Interocular area* with coarse contiguous punctures (some specimens finely rugose around antennal sockets); supra-clypeal protuberance as in *A. virescens*. (4) *Vertex* as in *A. virescens*. (5) *Gena* as in *A. virescens* but with carinae much finer. (6) *Malar area* yellow, never amber; short. (7) *Mandible* as in *A. virescens*. (8) *Antenna* as in *A. coloradinus*. **Mesosoma**: pubescence snowy white. (9) *Pronotum* as in *A. virescens* but with weaker sculpturing. (10) *Mesoscutum* as in *A. virescens* but with finer punctures and with anterior margin punctate. (11-13) *Mesoscutellum*, *metanotum* and *metepisternum* as in *A. virescens* but with finer sculpturing. (14-17) *Metepisternum*, *propodeum*, *wing* and *tegula* as in *A. coloradinus*. (18-20) *Fore*, *middle* and *hind legs* as in *A. virescens* but posterior surfaces of tibiae and femora nearly completely covered with dark brown to brown-black, and usually with small yellow rim apically on ventral surface of trochanters (Fig. 159). **Metasoma**: (21-22) *Terga* and *sterna* as in *A. coloradinus* but with creamy band on tergum 1 almost always broadly interrupted medially. (23) *Genitalia* (Figs. 184, 198, 227) as in *A. virescens* but with much smaller fold on medial plate of gonostylus and with prominent dorsal crest on penis valve.

## FEMALE (Figs. 29, 51-52)

General coloration of head and mesosoma bright metallic blue-green, metasoma black with white hair bands. **Head** (Figs. 51-52): (1) *Labrum* as in *A. texanus*. (2-4) *Clypeus*, *interocular area* and *vertex* as in *A. virescens* but with center of supra-clypeal protuberance shiny and nearly impunctate. (5) *Gena* as in *A. virescens* but with much finer and more numerous (5-6 per 0.25 mm) carinulae. (6) *Malar area* very dark ferruginous to brown-black; very narrow, almost absent. (7-8) *Mandible* and *antenna* as in *A. coloradinus*. **Mesosoma**: snowy white pubescence sometimes very slightly fuliginous on mesonotum and metanotum. (9-15) *Pronotum*, *mesoscutum*, *mesoscutellum*, *metanotum*, *mesepisternum*, *metepisternum* and *propodeum* as in *A. virescens* but with sculpturing slightly shallower and finer. (16) *Wing* as in *A. virescens* but always clear, never slightly amber. (17) *Tegula* as in *A. virescens* but dark amber (also darker than in *A. coloradinus*). (18-20) *Fore*, *middle* and *hind legs* as in *A. virescens* but with pubescence slightly paler. **Metasoma**: (21) *Terga* as in *A. virescens*

but with pubescence on 5-6 paler brown. (22) *Sterna* as in *A. virescens* but darker.

### *Agapostemon viequesensis* Cockerell

*Agapostemon viequesensis* Cockerell 1918b. Type ♀, U.S. National Museum.

*Agapostemon radiatus portoricensis* Cockerell 1919 (new synonymy). Type ♂, U.S. National Museum.

*Agapostemon portoricensis*. Wolcott, 1948.

I have seen the types of both *A. viequesensis* and *A. radiatus portoricensis* and have no doubt that they are conspecific.

DISTRIBUTION. In addition to the types I have seen specimens from the following Puerto Rican localities: Aguada (1 ♂, 9 Nov.), Arecibo (4 ♀, 24-26 June; 1 ♂ & 7 ♀, 30 July-1 Aug.), Caguas (4 ♂, 28-29 May), Coamo Springs (2 ♂, 28 Dec.; 1 ♀, 29 Dec.), Dorado (1 ♂, 15 July; 1 ♀, 12 Apr.), Guayanilla (1 ♂, 22 July), Manati (2 ♂, 5 Mar.; 1 ♂, 7 June), Mayaguez (1 ♂, Mar.; 2 ♀, 21-23 June; 1 ♀, 16 Dec.), Ponce (1 ♂, Jan.), Puerto Cangrejos (1 ♂, 28 Jan.), Río Piedras (1 ♂, 23 Mar.), San Juan (3 ♂, 11-14 Feb.; 1 ♀, 14 Apr.; 1 ♂, 9-12 July), Vega Alta (1 ♀, 27 Oct.) and Mona Island (1 ♂ & 1 ♀, 21-26 Feb.; 2 ♂, Aug.). I have also seen specimens from Nassau, New Providence I. (1 ♂ & 2 ♀, 16 Dec.) and Arthurs Town, Cat I. (1 ♀, July-Aug.).

DIAGNOSIS. The male may be distinguished from *A. centratus* and *A. kohliellus* by its toothed hind femora; from *A. viridulus*, *A. obscuratus*, *A. hispaniolicus*, *A. swainsonae* and *A. cubensis* by its lack of an elongate clypeal region; from *A. cyaneus*, *A. sapphirinus* and *A. ochromops* by its lack of milky to yellowish eyes and pterostigma; from *A. insularis*, *A. jamaicensis* and *A. poeyi* by its lack of metallic green or blue medially on metasomal tergum 3; and from *A. columbi* by its lack of metallic green tints medially on metasomal tergum 3. The female may be distinguished from other West Indian species with metallic metasomas by its lack of milky to yellowish eyes and pterostigma and by the tints at the base of its mandible.

#### DESCRIPTION

##### MALE (Figs. 117-118, 145, 187, 224)

General coloration of head and mesosoma metallic blue-green, metasoma with brown-black and yellow bands. **Head** (Figs. 117-118): (1) *Labrum* yellow with apical margin transparent; basal ridge with very slight or no medial depression, apical  $\frac{1}{2}$  triangular; glabrous but for submarginal row of simple bristles. (2) *Clypeus* green above, yellow below; punctures scattered and small on yellow area, becoming larger and more numerous on green area; short white scattered hairs on green area almost absent from yellow area. (3) *Interocular area* blue-green above, becoming yellow-green below; rugose, becoming coarsely, deeply and contiguously punctate above

antennal sockets; pubescence yellowish to creamy,  $\frac{3}{4}$  as long as scape between antennal sockets, becoming shorter laterally and ventrally, and becoming white and tomentose ventro-laterally. (4) *Vertex* with deep, contiguous, medium punctures anteriorly, becoming smaller and shallower laterally; rugose posteriorly, becoming irregularly rugulose between ocelli; pubescence as on interocular area but somewhat darker in color. (5) *Gena* with weak, fine, short rugulae extending postero-dorsally from antero-ventral margin; pubescence white, 1.5-2.0 times as long postero-medially as between antennal sockets but becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* absent or very short. (7) *Mandible* yellow, apical  $\frac{1}{3}$  ferruginous; single row of bristles postero-ventrally, longest basally, becoming  $\frac{1}{3}$  as long distally. (8) *Antenna* with scape yellow, becoming dark brown to brown-black on distal  $\frac{1}{2}$ - $\frac{1}{3}$  of upper surface; pedicel and flagellum dark brown to brown-black above, becoming pale amber to yellow below; apical flagellar segment yellow above and pedicel often slightly darker than flagellum. **Mesosoma:** pubescence wholly white or tinged with yellow on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe rounded; several to many fine, horizontal carinulae on postero-lateral area; pubescence on dorsal portions of lateral angle and posterior lobe as on mesoscutum, becoming very short, fine and inconspicuous on postero-lateral area. (10) *Mesoscutum* blue-green from above, yellow-green in oblique view; very finely and contiguously punctate, becoming rugose antero-laterally. (11) *Mesoscutellum* shinier than mesoscutum, with scattered large punctures interspersed with more numerous smaller and shallower punctures (faintly rugulose in some specimens). (12) *Metanotum* rugose. (13) *Mesepisternum* rugose anteriorly, becoming rugulose posteriorly and ventrally. (14) *Metepisternum* horizontally rugose. (15) *Propodeum* with distinct propodeal carina; coarsely rugose on propodeal shield, and posteriorly on dorsal portion, becoming moderately rugose antero-laterally; antero-dorsal margin with short rugae extending postero-laterally. (16) *Wing* transparent, slightly tinged with brown; radius brown-black, other veins and pterostigma brown. (17) *Tegula* pale transparent amber with metallic green tints antero-basally and yellow band almost reaching distal margin. (18-19) *Fore* and *middle legs* with coxae metallic green (only weakly tinted on middle leg), trochanters amber and remaining segments yellow with posterior of tibiae amber; pubescence pale amber. (20) *Hind leg* with coxa green, trochanter brown, femur yellow with brown dorsally on apical  $\frac{1}{3}$ , tibia dark amber to brown dorsally, becoming yellow ventrally, tarsus yellow; pubescence amber (Fig. 145). **Metasoma:** (21) *Terga* with yellow band on basal  $\frac{1}{2}$  of dorsal areas; anterior portion of tergum 1 amber; anterior  $\frac{1}{2}$  of dorsal areas brown, darkest anteriorly and becoming transparent on posterior margin; terga 4-5 often with very faint metallic green

tints laterally. Apex of pygidium rounded (Fig. 224). Pubescence very minute, inconspicuous; white on yellow bands becoming brown on brown bands. Longer hairs white on anterior surface of tergum 1 and ventro-laterally on terga 2-5, and becoming brown dorsally on terga 5-7. (22) *Sterna* yellowish to amber or pale brown with metallic green tints basally on sternum 1. Sternum 4 with posterior margin slightly concave, and with low submarginal transverse ridge most prominent laterally; scattered white hairs on exposed areas. (23) *Genitalia* (Fig. 187) as in *A. poeyi* but apical stylus on gonostylus not as swollen at apex.

FEMALE (Figs. 9, 11, 13, 15, 17, 39-40)

General coloration of head, mesosoma and metasoma bright metallic green to blue-green. **Head** (Figs. 15, 17, 39-40): pubescence white, becoming fuliginous on vertex. (1) *Labrum* as in *A. hispaniolicus*. (2) *Clypeus* green above and brown to brown-black below; lower  $\frac{1}{2}$  with large punctures separated by at least their diameters, punctures on upper  $\frac{1}{2}$  slightly obscured by faint transverse rugae; pubescence sparse, white, longest dorsally, shortest and least abundant ventrally, row of long amber bristles on lower margin. (3) *Interocular area* with large, deep, contiguous punctures centrally on upper  $\frac{1}{3}$  becoming moderately rugose laterally and on lower  $\frac{2}{3}$ ; rugae nearest inner margins of compound eyes irregularly vertical in orientation. Pubescence  $\frac{1}{3}$ - $\frac{1}{2}$  as long between antennal sockets as scape, becoming shorter ventrally and laterally. (4) *Vertex* with large, deep, contiguous punctures anteriorly and laterally, becoming rugose posteriorly and rugulose between ocelli. (5) *Gena* with fine carinulae extending dorso-laterally from antero-ventral margin; pubescence postero-medially twice as long as pubescence between antennal sockets, becoming shorter anteriorly, laterally and dorsally. (6) *Malar area* brown, very short to absent. (7) *Mandible* amber with apical  $\frac{1}{3}$  ferruginous; single row of hairs on postero-ventral margin long basally, becoming  $\frac{1}{3}$  as long distally. (8) *Antenna* brown-black above, slightly paler below; pedicel, proximal and distal flagellomeres often paler below than scape and remainder of flagellum. **Mesosoma**: (Figs. 9, 11, 13): pubescence white, becoming slightly fuliginous on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe rounded; postero-lateral area with 3-6 weak, horizontal carinulae; pubescence above lateral angle and posterior lobe like that on mesoscutum; lateral surface with very fine, inconspicuous, short, white hairs. (10) *Mesoscutum* with very fine, contiguous punctures, becoming shallowly rugulose antero-laterally. (11) *Mesoscutellum* with scattered large, deep punctures interspersed with far more numerous very small, shallow punctures. (12) *Metanotum* rugose. (13) *Mesepisternum* rugose with rugae finest posteriorly (specimens from Nassau, Bahamas with slightly coarser



sculpturing). (14) *Metepisternum* with regular horizontal carinulae. (15) *Propodeum* with strong propodeal carina; propodeal shield rugose or with irregular anastomosing rugae extending dorso-laterally from medial groove; dorsal area finely rugulose medially, laterally with anastomosing short carinae extending postero-laterally from anterior margin; lateral area with weak carinulae extending postero-dorsally from antero-lateral margin; pubescence very short and fine dorsally (absent medially), with long hairs posteriorly and laterally. (16) *Wing* as in ♂. (17) *Tegula* dark amber to brown with green tints antero-basally with faint (often obscure) yellow band almost reaching distal margin. (18-20) *Fore, middle and hind legs* with coxae dark brown; with metallic tints on anterior surface of fore coxa and dorsal surface of hind coxa; trochanters brown, remaining segments amber; pubescence white to pale amber, becoming dark brown dorsally on middle tibia, hind tibia and apex of hind femur. **Metasoma:** (21) *Terga* shiny metallic green with central brown band (varies greatly in size) devoid or nearly devoid of metallic tints; very fine, inconspicuous basal band of tomentum; medium length white to yellowish hairs ventro-laterally on terga 2-4 and anteriorly on tergum 1; long black hairs dorsally on terga 5-6. (22) *Sterna* amber to brown (faint metallic tints on specimens from New Providence I.); long white to yellowish, scattered hairs on exposed areas.

### *Agapostemon virescens* (Fabricius)

*Andrena virescens* Fabricius 1775. Type ♀, British Museum (Natural History).

*Andrena nigricornis* Fabricius 1793. Types ♂, Zoologiske Museum, Copenhagen.

*Halictus dimidiatus* Lepeletier 1841. Type ♀, whereabouts unknown.

*Halictus tricolor* Lepeletier 1841 (new synonymy). Type ♂, Istituto e Museo di Zoologia, Università di Torino, Italy.

*Agapostemon bicolor* Robertson 1893. Type ♀, Illinois Natural History Survey.

The synonymy of *Andrena nigricornis* Fabricius and *Halictus dimidiatus* Lepeletier with *Andrena virescens* Fabricius is based on their descriptions. C. D. Michener examined the type of *A. virescens* in the British Museum. G. C. Eickwort examined the type of *Agapostemon bicolor* in Urbana, Illinois, and confirmed Robertson's synonymy (1895) of this species with *A. virescens*. I have examined the type of *H. tricolor* and it is a synonym of *A. virescens*, not *A. radiatus* as stated by Sandhouse (1936).

Van der Vecht (1959) suggests that *Apis sericea* Forster (1771) may be a senior synonym of *A. virescens*, but the description given by Forster does not warrant such a conclusion (cf. *Nomina Dubia*).

**DISTRIBUTION** (Fig. 30). Specimens have been collected as far east as Penobscot Co. in central Maine; as far west as Coos Co. on the Oregon Coast; as far south as Hernando Co. on the central western coast of Florida; and as far north as Vernon, British Columbia. This distribution is unusual inasmuch as it is wide, ranging from coast to coast, yet this species is com-

mon only from about 37° to 47° North latitude. In the northwestern part of the range (British Columbia and Alberta) males have been collected from August through October, and females from April through August and in October. In the central part of the range (Nebraska) males have been collected from July through October, and females from May through October. In the southeastern part of the range (Virginia, Tennessee, North Carolina and Georgia) males have been collected from June through September and in November, and females from May through August and in October. Although *A. virescens* occurs primarily at elevations of less than 2,000 ft. (610 m), I have seen specimens from as high as 4,000 ft. (1,219 m) on Middle Mountain, Virginia; 6,900 ft. (2,103 m) near Boulder, Colorado; and 7,000 ft. (2,134 m) near Salt Lake City, Utah.

**DIAGNOSIS.** The male may be distinguished from many other North American species by the lack of yellow maculations on its brown to brown-black sterna 5-6, by its medial ridge on the apical  $\frac{1}{2}$  of sternum 6 (last visible sternum), and by its gonostylus (Fig. 183); from *A. coloradinus* and *A. tyleri* by the restriction of brown to brown-black areas on the posterior surface of its hind leg to basal and apical regions of femur and tibia, and by its lack of a prominent dorsal crest on its penis valve. The females may be distinguished from other species occurring north of Mexico by its black metasomal terga and the lack of yellow on its clypeus; from females of *A. coloradinus* and *A. tyleri* by the coarser carinae on its gena (2-3 per 0.25 mm in *A. virescens*, 5-6 per 0.25 mm in *A. coloradinus* and *A. tyleri*), and its largely yellow mandibles (amber to brown in *A. coloradinus* and dark brown in *A. tyleri*).

#### DESCRIPTION

##### MALE (Figs. 97-98, 158, 183, 197)

General coloration of head and mesosoma bright metallic green, metasoma with black and yellow bands. **Head** (Figs. 97-98): pubescence white becoming yellowish to pale amber on vertex. (1) *Labrum* as in *A. texanus* but slightly blunter at apex. (2) *Clypeus* with medium size, shallow, scattered punctures on yellow portion, becoming more dense and slightly larger above. (3) *Interocular area* with large deep contiguous punctures below ocelli, becoming rugose and more shallowly sculptured below; supra-clypeal protuberance shallowly rugose to punctate with few faint horizontal rugae. (4) *Vertex* with deep contiguous punctures anteriorly, becoming more finely punctate laterally, and coarsely but shallowly rugose posteriorly and between ocelli. (5) *Gena* with numerous short, parallel, subcontiguous carinae extending dorso-laterally from antero-ventral margin. (6) *Malar area* bright yellow to pale amber; short. (7) *Mandible* bright yellow with apical  $\frac{1}{3}$  ferruginous. (8) *Antenna* brown to brown-black above with shiny pale area on apical  $\frac{1}{2}$  of apical flagellomere; flagellum pale amber to brown

below; and underside of scape and pedicel yellow to largely black with yellow apically. **Mesosoma:** pubescence white, becoming pale amber to yellowish on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe neither very rounded nor acute; postero-lateral area with large, broad, low, vertical ridge just anterior to numerous very fine and faint carinulae. (10) *Mesoscutum* with fine contiguous punctures becoming finely rugose anteriorly and antero-laterally. (11) *Mesoscutellum* with punctures like those of mesoscutum but somewhat larger and less dense (especially laterally). (12) *Metanotum* finely and deeply rugose. (13) *Mesepisternum* coarsely rugose anteriorly, becoming finely rugose posteriorly. (14) *Metepisternum* with irregular horizontal carinae, anastomosing so as to appear largely rugose on some specimens. (15) *Propodeum* with distinct propodeal carina; propodeal shield coarsely and shallowly rugose; dorsal area coarsely rugose, postero-lateral area moderately rugose, becoming finely rugose to coarsely punctate antero-laterally. (16) *Wing* clear to transparent amber with apical regions slightly darkened. Radial vein dark brown, stigma and remaining veins pale brown. (17) *Tegula* pale transparent amber with green tints antero-basally, short transverse yellow band on anterior area curving rearward and almost reaching distal margin; posterior margin yellow. (18) *Fore leg* yellow with coxa bright metallic green; trochanter dark brown; femur with brown basally and postero-dorsally on basal  $\frac{1}{2}$  of tibia. Pubescence white to pale yellow. (19) *Middle leg* like fore leg but with only faint green tints on coxa and with brown streak postero-dorsally on basal  $\frac{1}{2}$ - $\frac{3}{4}$  of tibia. Pubescence white to pale yellow. (20) *Hind leg* (Fig. 158) with coxa bright metallic green; trochanter brown (sometimes with faint metallic tints); femur yellow with brown at base and apex; tibia yellow with brown at base (and sometimes at apex) and brown streak centrally on antero-dorsal surface. Pubescence white to pale yellow. **Metasoma:** (21) *Terga* brown to brown-black with yellow bands on basal halves of terga 2-5 and narrow yellow band centrally on tergum 1; pubescence white, short and appressed on dorsal portions of terga 1-4, moderate length elsewhere. (22) *Sterna* brown to brown-black with yellow baso-laterally on sterna 2-4 (often hidden by overlapping sterna), and sternum 1 with metallic tints basally; apical  $\frac{1}{2}$  of sternum 6 with median ridge in shallow depression. Pubescence white and moderately long on exposed areas. (23) *Genitalia* (Figs. 183, 197) with dorsal crest of penis valve rounded and broad, not prominent as in most other species; ventral lobes of moderate size and distally fringed with hairs.

## FEMALE (Figs. 28, 53-54)

General coloration of head and mesosoma bright metallic green to blue-green, metasoma black with white hair bands. **Head** (Figs. 28,

53-54): pubescence white, becoming faintly yellowish at vertex (and on interocular area of some specimens). (1) *Labrum* as in *A. texanus*. (2) *Clypeus* with large scattered punctures below, becoming contiguous above. (3) *Interocular area* with deep, medium sized punctures above, becoming deeply but finely rugose below. (4) *Vertex* with deep, small, contiguous punctures anteriorly, finer and shallower laterally and becoming finely rugose posteriorly; area between ocelli finely rugose to punctate. (5) *Gena* with moderately fine (2-3 per 0.25 mm) parallel carinae extending postero-dorsally from antero-ventral margin. (6) *Malar area* amber to ferruginous and very short, almost absent. (7) *Mandible* yellow or rarely very pale amber; with apical  $\frac{1}{2}$ - $\frac{1}{3}$  ferruginous. (8) *Antenna* dark brown to brown-black with underside of flagellum slightly paler brown. **Mesosoma:** pubescence white, becoming pale amber to slightly fuliginous on mesonotum and metanotum. (9) *Pronotum* with lateral angle and posterior lobe neither very rounded nor acute; numerous very faint parallel carinulae extending antero-dorsally from postero-ventral area. (10) *Mesoscutum* with deep, medium sized, contiguous punctures becoming rugose anteriorly and antero-laterally. (11) *Mesoscutellum* with fine contiguous punctures medially, becoming large and separated by as much as 2-3 times their diameters laterally. (12) *Metanotum* rugulose. (13) *Mesepisternum* coarsely rugose, only very slightly finer rugae posteriorly. (14) *Metepisternum* with moderately coarse carinae regular and parallel anteriorly, irregular and anastomosing posteriorly. (15) *Propodeum* with prominent propodeal carina; propodeal shield with numerous weak carinae extending laterally and slightly dorsally from median groove; dorsal area with irregularly anastomosing carinae extending postero-laterally from anterior margin; lateral area with anastomosing horizontal rugae coarse posteriorly, becoming fine anteriorly. (16) *Wing* as in  $\delta$ . (17) *Tegula* as in  $\delta$  but slightly darker. (18-20) *Fore, middle and hind legs* brown to brown-black with yellow dorsally at apex of femur and base of tibia of fore and middle legs; dorsal surface of hind coxa with strong metallic tints; pubescence white to amber, becoming fuliginous apically on dorsal surface of middle leg and brown-black basally on antero-dorsal surface of hind leg. **Metasoma:** (21) *Terga* black; white tomentose hair bands basally on terga 2-4 and centrally on tergum 1 (often broadly interrupted medially); pubescence anteriorly on tergum 1 and laterally on terga 1-5 white and moderately long; pubescence dorsally on terga 5-6 moderately long and brown to black. (22) *Sterna* brown to brown-black with long, scattered white hairs on exposed areas.

### *Agapostemon viridulus* (Fabricius)

*Apis viridula* Fabricius 1793. Type ♀, Lund collection, Zoologiske Museum, Copenhagen.

*Andrena (Agapostemon) femoralis* Guérin-Ménéville 1844. Type ♂, Musco Civico di Storia Naturale di Genova, Genoa.

*Agapostemon semiviridis* Cresson 1865 (new synonymy). Type ♀, Academy of Natural Sciences, Philadelphia.

*Agapostemon viridulus*. Dalla Torre, 1896.

J. S. Moure has selected a lectotype of *Apis viridula* and redescribed it (Moure, 1960). C. D. Michener has examined the type of *Andrena* (*Agapostemon*) *femoralis*, and I have examined the lectotype of *Agapostemon semiviridis*. I have no doubt that all three are conspecific. It should be noted that owing to the inadequacy of the original description *Agapostemon viridulus* was believed by many authors to be a synonym of *Agapostemon virescens*.

Except for the coloration of the head and thorax this species is indistinguishable from *Agapostemon obscuratus* Cresson. Sympatry and the absence of intermediate forms lead me to conclude that *A. obscuratus* is not conspecific with *A. viridulus*.

DISTRIBUTION. I have seen specimens from the following localities in Cuba: Baracoa (3 ♂, Aug.), Castillo de Juaga, Cienfuegos (8 ♀, 4-5 Sept.), Central Jaronu (4 ♂, 31 Mar.), Cristo (4 ♂, 3 Oct.), Guane (2 ♂ & 1 ♀, 24-26 Sept.), Guantanamo (5 ♂ & 1 ♀), Havana (8 ♂), Puerto Baniato, Santiago de Cuba (1 ♂, Nov.), Río Toa, Baracoa (2 ♂, 26 Apr.), San Blas (1 ♂, 12 Aug.), Santiago de las Vegas (1 ♀, 10 Feb.), Siboney (1 ♀, Feb.), Soledad (1 ♂, 27 Feb.; 1 ♂, 4 Mar.; 1 ♂, 5 May), Trinidad Mts. (1 ♀, 28 Aug.), Vinales (2 ♀, 16-22 Sept.).

DIAGNOSIS. The male may be distinguished from West Indian species, except *A. obscuratus* and *A. hispaniolicus*, by its black metasomal terga; from *A. obscuratus* by its bright metallic blue-green head and mesosoma; from *A. hispaniolicus* by the subcontiguous punctures of its mesoscutum. The female may be distinguished from West Indian species, except *A. obscuratus*, *A. hispaniolicus* and *A. swainsonae*, by its black metasomal terga; from *A. obscuratus* by its bright metallic blue-green head and mesosoma; from *A. swainsonae* by the metallic green tints on the base of its mandible; and from *A. hispaniolicus* by the coarser sculpturing of its interocular area.

#### DESCRIPTION

MALE (Figs. 111-112, 150, 178, 208)

General coloration of head and mesosoma metallic green to blue-green, metasoma dark brown to black. **Head** (Figs. 111-112): (1) *Labrum* yellow to white on basal  $\frac{1}{2}$ , amber to brown on apical  $\frac{1}{2}$ ; apex smoothly rounded (not acute), basal  $\frac{1}{2}$  with shallow depression medially on transverse ridge; shiny and impunctate; pubescence limited to about 20 subapical bristles. (2) *Clypeus* yellow to white below and extraordinarily elongate; punctures coarse and scattered, weak transverse rugae medially on upper  $\frac{1}{2}$ ; pubescence short, sparse and white. (3) *Interocular area* with contiguous



punctures below median ocellus, becoming rugose midway between median ocellus and antennal sockets, rugosity at level of antennal sockets changing to scattered punctures ventro-laterally; supraclypeal protuberance with coarse scattered punctures and transverse medial rugae; pubescence white, nearly as long between antennal sockets as scape, becoming shorter laterally, dorsally and ventrally; ventro-lateral area near malar space with short, sparse, white tomentum. (4) *Vertex* with fine, contiguous punctures anteriorly and laterally, becoming rugose posteriorly; area between ocelli sparsely punctate; pubescence white, fuliginous between ocelli. (5) *Gena* with fine parallel rugae running postero-dorsally from antero-ventral margin; pubescence white and about 1.5 times as long postero-medially as pubescence between antennal sockets, becoming shorter laterally, anteriorly and dorsally. (6) *Malar area* yellowish, more than  $\frac{1}{2}$  as broad as long; shiny and impunctate; pubescence sparse, appressed, short and white. (7) *Mandible* yellow to creamy, apical  $\frac{1}{3}$ - $\frac{1}{4}$  transparent ferruginous; simple hairs on postero-ventral margin of mandible longest basally, becoming  $\frac{1}{3}$  as long apically. (8) *Antenna* with scape brown-black above, yellow below; pedicel dark brown; flagellum brown-black above, paler brown below. **Meso-***soma*: pubescence fuliginous on mesonotum and metanotum, white laterally, ventrally and on propodeum. (9) *Pronotum* with lateral angle and posterior lobe rounded; sculpturing inconspicuous. Pubescence postero-laterally very fine, short and inconspicuous; dorsally on lateral angle and posterior lobe similar in length and color to that of mesonotum. (10) *Mesoscutum* with very fine, deep, contiguous punctures, becoming rugulose antero-laterally. (11) *Mesoscutellum* shiny with large, scattered, central punctures, becoming finer and more numerous anteriorly. (12) *Metanotum* finely and irregularly rugulose with large, scattered punctures. (13) *Mesepisternum* coarsely to moderately rugose anteriorly, becoming finely rugose posteriorly. (14) *Metepisternum* finely and horizontally carinate. (15) *Propodeum* rounded posteriorly; propodeal carina absent; fine, even, horizontal carinulae laterally and posteriorly (uppermost of these becoming stronger along upper margin of propodeal shield); dorsal area of propodeum with fine, even carinulae running postero-laterally from posterior margin of metanotum. (16) *Wing* transparent, faintly fuliginous; veins and pterostigma dark brown, radius almost black. (17) *Tegula* dark transparent brown with metallic green tints on basal margin and submarginally on anterior  $\frac{1}{3}$  and with very fine scattered punctures. (18) *Fore leg* dark brown with yellow to white on antero-ventral surface of femur, on all but posterior surface of tibia, and on tarsus; coxa metallic green; pubescence white proximally, becoming amber distally. (19) *Middle leg* similar in color and pubescence to fore leg but with white to yellow areas on femur and tibia reduced, and with tarsus amber to brown, coxa slightly metallic

green. (20) *Hind leg* (Fig. 150) with coxa largely metallic green to blue; trochanter brown with metallic tints; femur brown with yellow to white antero-ventrally, on basal  $\frac{2}{3}$  antero-dorsally, and posteriorly around large tooth; tibia brown with yellow to white ventrally and antero-ventrally (yellow sometimes very reduced or absent); tarsus brown to amber. Hind leg very swollen, especially femur; basal ridge on basitarsus very prominent, broad and concave; apical groove broad and delimited by strong carina; pubescence amber on tarsus, white on other segments. **Metasoma:** (21) *Terga* brown-black (pygidium somewhat paler) and shiny; with long, sparse, white pubescence becoming fuliginous around pygidium and with very short, moderately dense pubescence brown-black and inconspicuous, and with narrow, basal bands of white tomentum on terga 2-6 (often hidden by preceding terga). (22) *Sterna* not quite as dark as terga, sternum 1 with metallic green tints basally; with sparse white pubescence on exposed portions. (23) *Genitalia* (Figs. 178, 208) with penis valves smooth basally on dorsal surface, with large dorsal crest grooved at apex. Gonocoxa with numerous deep longitudinal grooves laterally; gonostylus with simple apical stylus; medial plate with small fold on antero-medial margin; ventral lobes large, curled posteriorly and with dense, short, simple pubescence marginally on posterior surface.

## FEMALE (Figs. 33-34)

General coloration of head and mesosoma metallic green to blue-green, metasoma black with narrow bands of white tomentum. **Head** (Figs. 33-34): pubescence white, fuliginous on vertex, and amber on lower margin of clypeus and on mandibles. (1) *Labrum* (Figs. 34 A-C) brown, with large, broad, distal keel; basal area with rounded medial protuberance and sharply delimited from distal process by marginal carina; additional transverse carina present between base of distal process and outer margin of basal area. (2) *Clypeus* elongate and with broad, very shallow, subapical depression or flattened area; punctures very coarse, widely separated distally, becoming more numerous above; irregular transverse rugae often scattered on metallic area. (3) *Interocular area* rugose, becoming punctate at vertex; supra-clypeal protuberance with scattered punctures and regular transverse rugae. (4) *Vertex* finely and densely punctate anterior to and lateral to ocellar triangle, becoming shallowly and weakly rugose posterior to ocelli; area between ocelli with fine, scattered punctures. (5) *Gena* with numerous, regular, contiguous rugulae running postero-dorsally from antero-ventral margin. (6) *Malar area* very short, almost non-existent. (7) *Mandible* dark ferruginous brown with metallic green tints at base. (8) *Antenna* brown-black, slightly paler on underside of flagellum. **Mesosoma:** pubescence as in ♂. (9) *Pronotum* with lateral angle and posterior lobe rounded; weak carina running postero-laterally downward from lateral angle. (10) *Mesoscutum*

with dense, fine punctures contiguous centrally, becoming separated by about  $\frac{1}{2}$  their diameters posteriorly and becoming finely rugulose anteriorly. (11) *Mesoscutellum* with scattered medium punctures interspersed with more numerous fine punctures anteriorly, and finely rugulose posteriorly and laterally. (12) *Metanotum* with very faint rugulae running postero-laterally from anterior margin. (13) *Mesepisternum* moderately rugose; rugae moderately prominent anteriorly, becoming finer posteriorly. (14) *Metepisternum* finely, horizontally carinulate, with carinulae more numerous and less prominent than on  $\delta$ . (15) *Propodeum* not rounded posteriorly and with definite propodeal carina; carinulae on lateral and dorsal areas similar to  $\delta$ ; numerous parallel carinulae on propodeal shield running dorso-laterally from median groove. (16-17) *Wing* and *tegula* as on  $\delta$ . (18-20) *Fore, middle* and *hind legs* brown-black to amber; pubescence creamy to amber, fuliginous on dorsal surfaces of tibiae, dark brown to black adjacent to basi-tibial plate on hind leg; posterior tibial spur with 3-5 (usually 4) spatulate teeth. **Metasoma:** (21) *Terga* brown-black to black, anterior area of tergum 1 often brown to amber; dorsal surfaces finely granulose, not shiny; pubescence on ventro-lateral areas of terga 1-4 as well as on anterior surface of tergum 1 scattered, of moderate length and white; dorsal portions of terga with very numerous, minute, simple, brown-black hairs directed posteriorly; basal bands of white tomentum on terga 2-5 usually hidden by preceding terga but may be visible laterally; abundant long brown-black pubescence on terga 5-6. (22) *Sterna* brown to black with scattered, simple, long white hairs on exposed portions.

#### NOMINA DUBIA

In 1771, J. R. Forster described *Apis sericea* from North America. Van der Vecht (1959) has suggested that it is a senior synonym of *Agapostemon virescens* Fabricius 1775. Forster's very brief description is sufficient only to indicate that he had a male *Agapostemon*. Forster made no mention of characters of specific significance and, in the absence of the type, I can accord only the status of *nomen dubium* to *Apis sericea* Forster.

In 1903, J. Vachal described *Halictus (Agapostemon) chiriquiensis* from a single female. It would seem from the description to be either *A. nasutus* or *A. leunculus*. I requested the type but Dr. S. Kelner-Pillault was unable to find it in the Muséum National D'Histoire Naturelle in Paris. Therefore, I consider *Halictus (Agapostemon) chiriquiensis* a *nomen dubium*.

## APPENDIX A

The following list of plant communities in which *Agapostemon texanus* and *A. angelicus* may occur was derived by superimposing distributions of these species on the vegetation map of Küchler (1964). Only those communities present in the United States are listed, as comparable vegetation maps do not exist for Mexico and Central America. The letter "T" preceding a community indicates records of *A. texanus*, "A" indicates *A. angelicus*, and "TA" indicates both species. The numbers are those assigned to the communities by Küchler.

As Küchler's map is based on potential vegetation, this list may be unrealistically large, with the bees actually living in disturbed areas with little, if any, semblance of the potential climax or subclimax vegetation.

- T 1. Spruce—Cedar—Hemlock Forest (*Picea—Thuja—Tsuga*)
- T 2. Cedar—Hemlock—Douglas Fir Forest (*Thuja—Tsuga—Pseudotsuga*)
- T 3. Silver Fir—Douglas Fir Forest (*Abies—Pseudotsuga*)
- T 5. Mixed Conifer Forest (*Abies—Pinus—Pseudotsuga*)
- T 6. Redwood Forest (*Sequoia—Pseudotsuga*)
- T 7. Red Fir Forest (*Abies*)
- T 8. Lodgepole Pine—Subalpine Forest (*Pinus—Tsuga*)
- T 9. Pine—Cypress Forest (*Pinus—Cypressus*)
- T 10. Ponderosa Shrub Forest (*Pinus*)
- T 11. Western Ponderosa Forest (*Pinus*)
- T 12. Douglas Fir Forest (*Pseudotsuga*)
- T 13. Cedar—Hemlock—Pine Forest (*Thuja—Tsuga—Pinus*)
- T 14. Grand Fir—Douglas Fir Forest (*Abies—Pseudotsuga*)
- A 15. Western Spruce—Fir Forest (*Picea—Abies*)
- TA 17. Black Hills Pine Forest (*Pinus*)
- TA 18. Pine—Douglas Fir Forest (*Pinus—Pseudotsuga*)
- A 19. Arizona Pine Forest (*Pinus*)
- A 20. Spruce—Fir—Douglas Fir Forest (*Picea—Abies—Pseudotsuga*)
- A 21. Southwestern Spruce—Fir Forest (*Picea—Abies*)
- TA 23. Juniper—Pinyon Woodland (*Juniperus—Pinus*)
- T 29. California Mixed Evergreen Forest (*Quercus—Arbutus—Pseudotsuga*)
- T 30. California Oakwoods (*Quercus*)
- A 31. Oak—Juniper Woodland (*Quercus—Juniperus*)
- TA 32. Transition between 31 and 37
- TA 33. Chaparral (*Adenostoma—Arctostaphylos—Ceanothus*)
- T 35. Coastal Sagebrush (*Salvia—Eriogonum*)
- T 36. Mosaic of numbers 30 and 35
- TA 37. Mountain Mahogany—Oak Scrub (*Cercocarpus—Quercus*)
- TA 38. Great Basin Sagebrush (*Artemisia*)
- A 39. Blackbrush (*Coleogyne*)
- A 40. Saltbush—Greasewood (*Atriplex—Sarcobatus*)
- TA 41. Creosote Bush (*Larrea*)
- TA 42. Creosote Bush—Bur Sage (*Larrea—Franseria*)
- TA 43. Palo Verde—Cactus Shrub (*Cercidium—Opuntia*)
- TA 44. Creosote Bush—TARBUSH (*Larrea—Flourensia*)
- TA 45. Ceniza Shrub (*Leucophyllum—Larrea—Prosopis*)
- T 47. Fescue—Oatgrass (*Festuca—Danthonia*)
- T 48. California Steppe (*Stipa*)
- T 50. Fescue—Wheatgrass (*Festuca—Agropyron*)
- T 51. Wheatgrass—Blue Grass (*Agropyron—Poa*)
- TA 53. Grama—Galleta Steppe (*Bouteloua—Hilaria*)
- A 54. Grama—Tobosa Prairie (*Bouteloua—Hilaria*)
- TA 55. Sagebrush Steppe (*Artemisia—Agropyron*)
- A 58. Grama—Tobosa Shrub Steppe (*Bouteloua—Hilaria—Larrea*)
- TA 59. Trans-Pecos Shrub Savanna (*Flourensia—Larrea*)
- TA 60. Mesquite Savanna (*Prosopis—Hilaria*)

- T 61. Mesquite—Acacia Savanna (*Prosopis—Acacia—Andropogon—Setaria*)  
 T 62. Mesquite—Live Oak Savanna (*Prosopis—Quercus—Andropogon*)  
 T 63. Foothills Prairie (*Agropyron—Festuca—Stipa*)  
 T 64. Grama—Needlegrass—Wheatgrass (*Bouteloua—Stipa—Agropyron*)  
 TA 65. Grama—Buffalo Grass (*Bouteloua—Buchloë*)  
 TA 66. Wheatgrass—Needlegrass (*Agropyron—Stipa*)  
 TA 67. Wheatgrass—Bluestem—Needlegrass (*Agropyron—Andropogon—Stipa*)  
 TA 68. Wheatgrass—Gramma—Buffalo Grass (*Agropyron—Bouteloua—Buchloë*)  
 TA 69. Bluestem—Gramma Prairie (*Andropogon—Bouteloua*)  
 A 70. Sandsage—Bluestem Prairie (*Artemisia—Andropogon*)  
 TA 71. Shinnery (*Quercus—Andropogon*)  
 T 74. Bluestem Prairie (*Andropogon—Panicum—Sorghastrum*)  
 TA 75. Nebraska Sandhills Prairie (*Andropogon—Calamovilfa*)  
 TA 76. Blackland Prairie (*Andropogon—Stipa*)  
 T 77. Bluestem—Sachahuista Prairie (*Andropogon—Spartina*)  
 T 81. Oak Savanna (*Quercus—Andropogon*)  
 T 82. Mosaic of numbers 74 and 100  
 T 84. Cross Timbers (*Quercus—Andropogon*)  
 TA 85. Mesquite—Buffalo Grass (*Prosopis—Buchloë*)  
 TA 86. Juniper—Oak Savanna (*Juniperus—Quercus—Andropogon*)  
 TA 87. Mesquite—Oak Savanna (*Prosopis—Quercus—Andropogon*)  
 T 88. Fayette Prairie (*Andropogon—Buchloë*)  
 T 95. Great Lakes Pine Forest (*Pinus*)  
 TA 98. Northern Floodplain Forest (*Populus—Salix—Ulmus*)  
 T 99. Maple—Basswood Forest (*Acer—Tilia*)  
 T 100. Oak—Hickory Forest (*Quercus—Carya*)  
 T 102. Beech—Maple Forest (*Fagus—Acer*)  
 T 104. Appalachian Oak Forest (*Quercus*)  
 T 106. Northern Hardwoods (*Acer—Betula—Fagus—Tsuga*)  
 T 109. Transition between numbers 105 and 106  
 T 110. Northeastern Oak—Pine Forest (*Quercus—Pinus*)  
 T 111. Oak—Hickory—Pine Forest (*Quercus—Carya—Pinus*)  
 T 113. Southern Floodplain Forest (*Quercus—Nyssa—Taxodium*)

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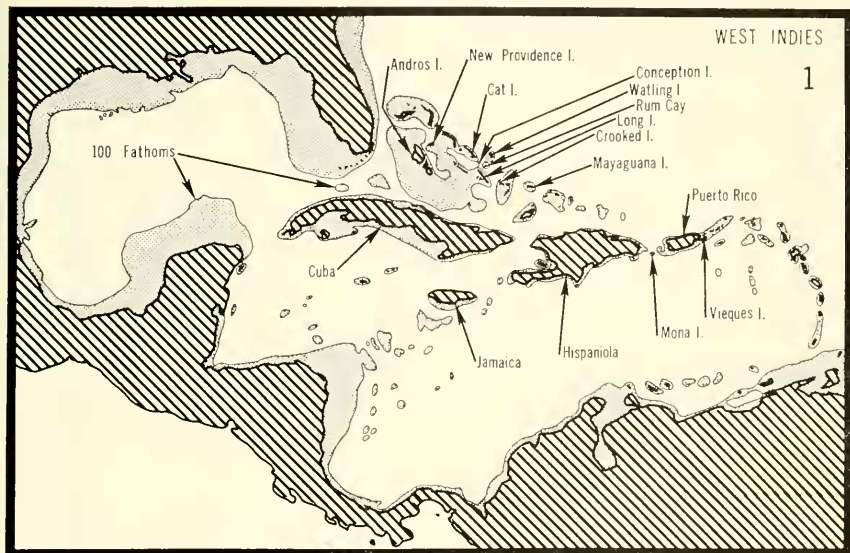


FIG. 1. Distributions of West Indian *Agapostemon* (stippled regions less than 100 fathoms in depth).

	Andros	New Providence	Cat	Conception	Watling	Rum	Long	Crooked	Mayaguana	Cuba	Hispaniola	Jamaica	Mona	Puerto Rico	Vieques	Costa Rica ?
<i>poeyi</i>	×	×	×	...	...	...	...	...	...	×	×	...	...	×	×	..
<i>viequesensis</i>	...	×	×	×	...	×	...	...	×	...	...	...	×	×	×	..
<i>ochromops</i>	...	×	×	×	...	×	...	...	×	...	...	...	...	...	...	..
<i>columbi</i>	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	..
<i>sapphirinus</i>	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	..
<i>cyaneus</i>	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	..
<i>insularis</i>	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	..
<i>jamaicensis</i>	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	..
<i>aenigma</i>	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	?
<i>viridulus</i>	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	..
<i>obscuratus</i>	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	..
<i>cubensis</i>	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	..
<i>alayi</i>	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	..
<i>hispaniolicus</i>	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	..
<i>swainsonae</i>	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	..
<i>kohliellus</i>	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...	..
<i>centratus</i>	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	?

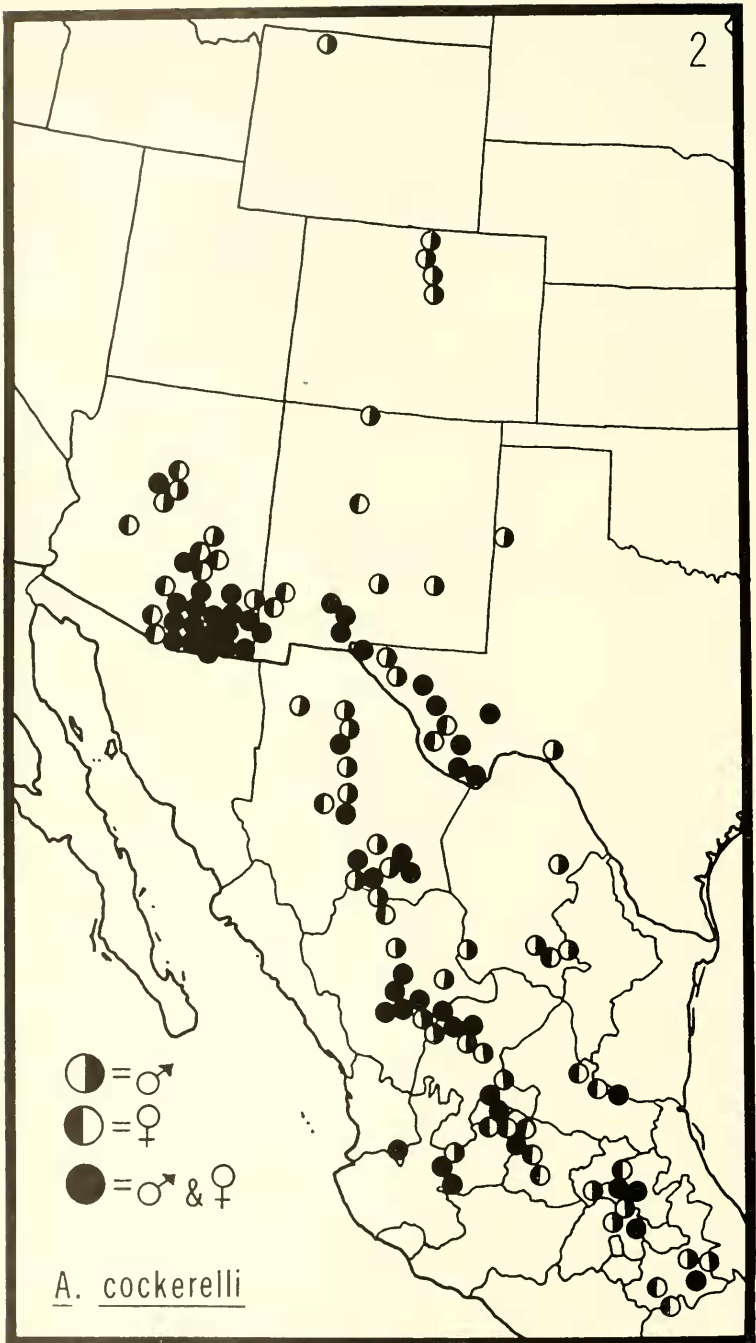


FIG. 2. Distribution of *Agapostemon cockerelli*.

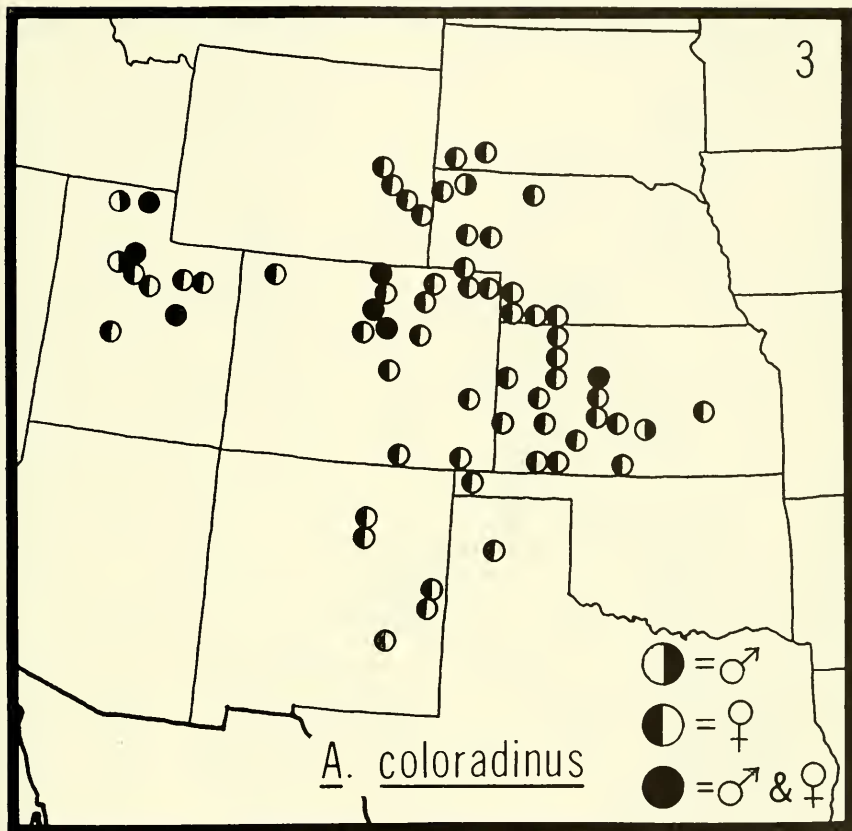
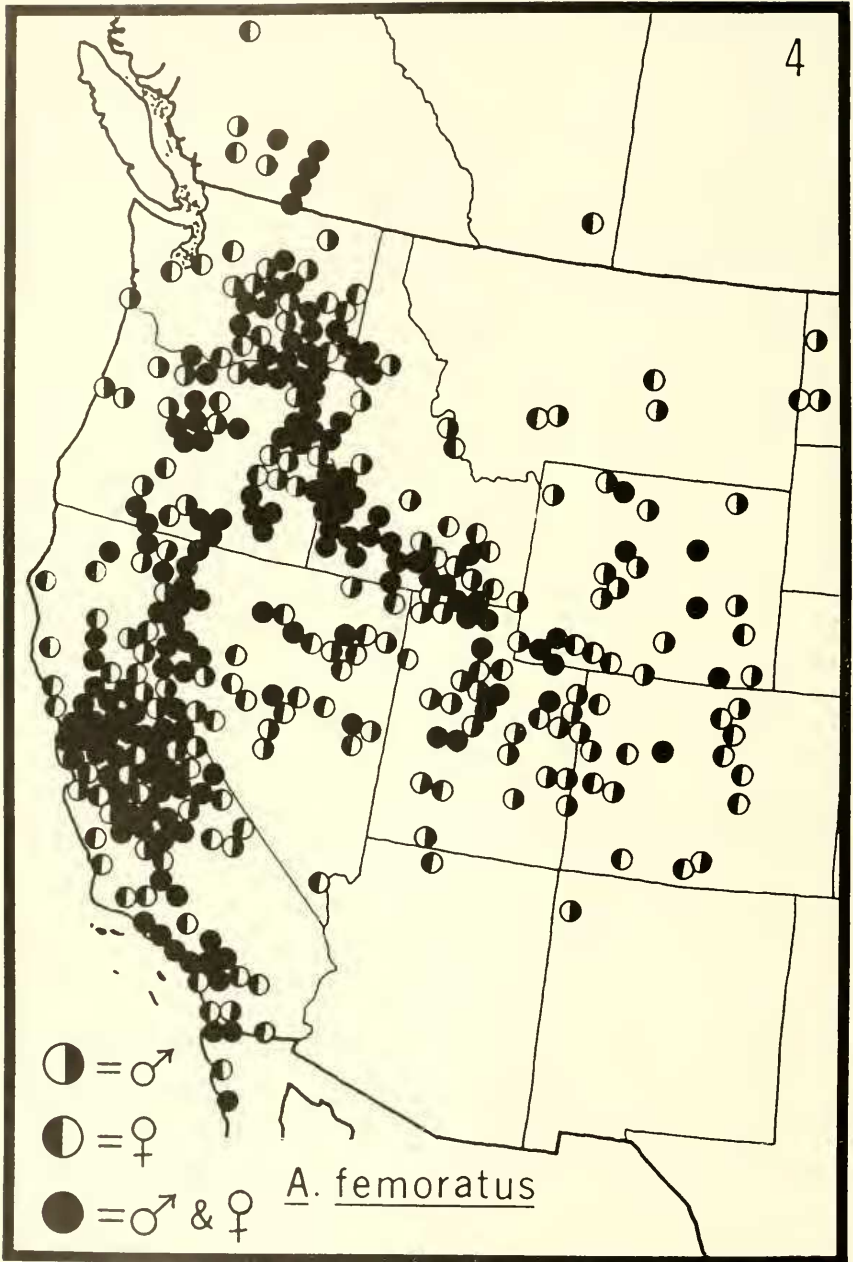
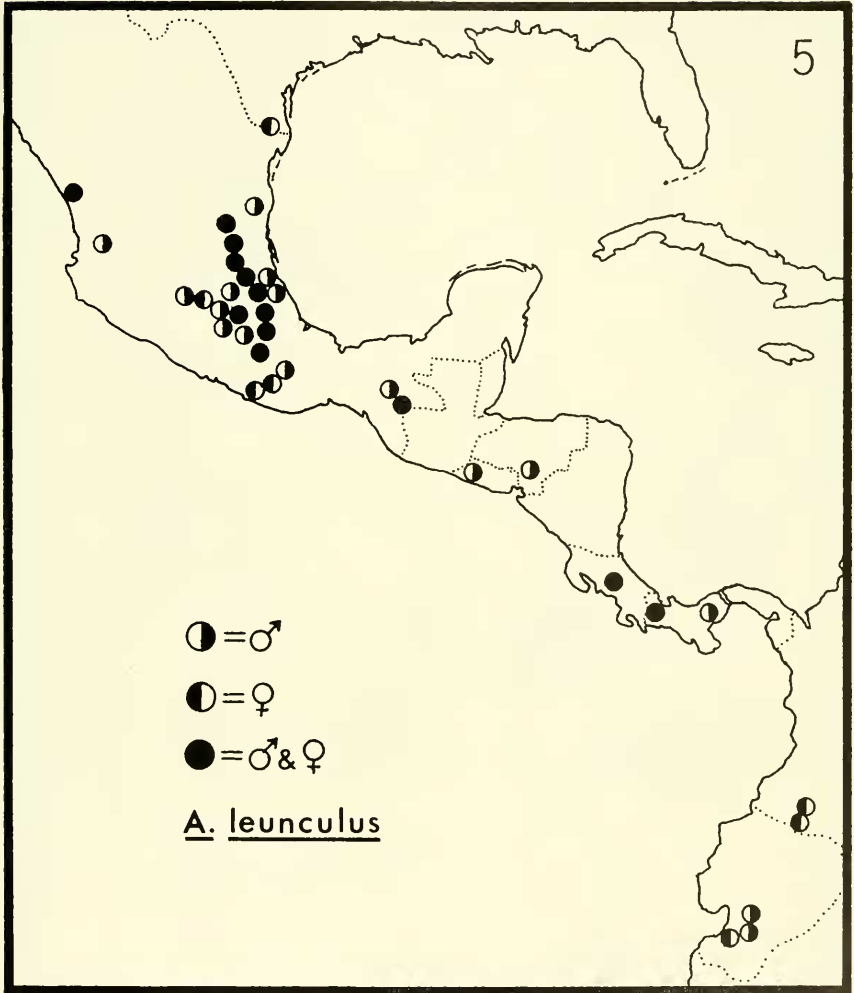


FIG. 3. Distribution of *Agapostemon coloradinus*.



FIG. 4. Distribution of *Agapostemon femoratus*.

FIG. 5. Distribution of *Agapostemon leunculus*.

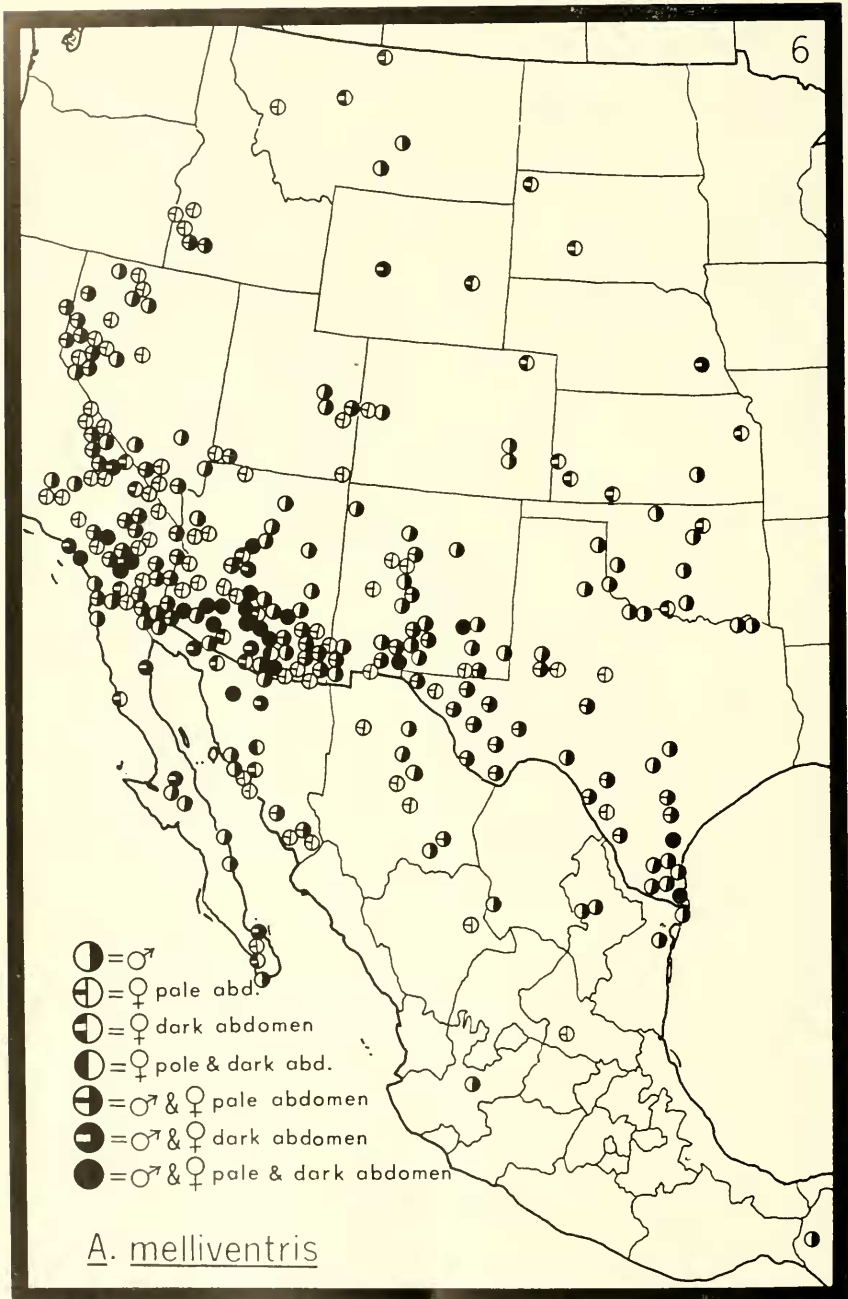


FIG. 6. Distribution of *Agapostemon melliventris*. Color of the metasomal terga of females is indicated by "dark abdomen" (=brown-black to black) and "pale abdomen" (=amber).

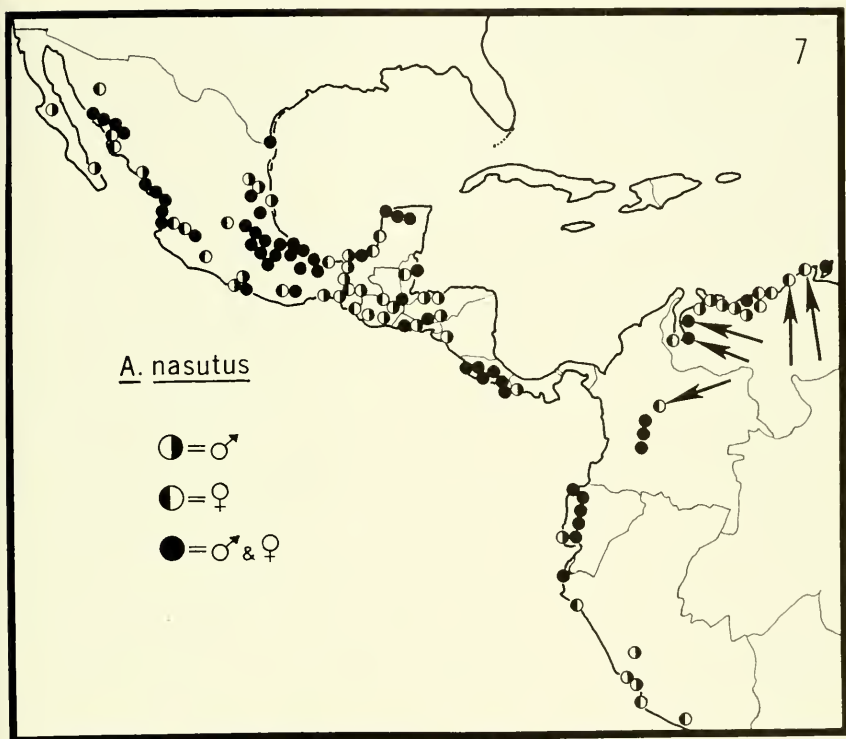
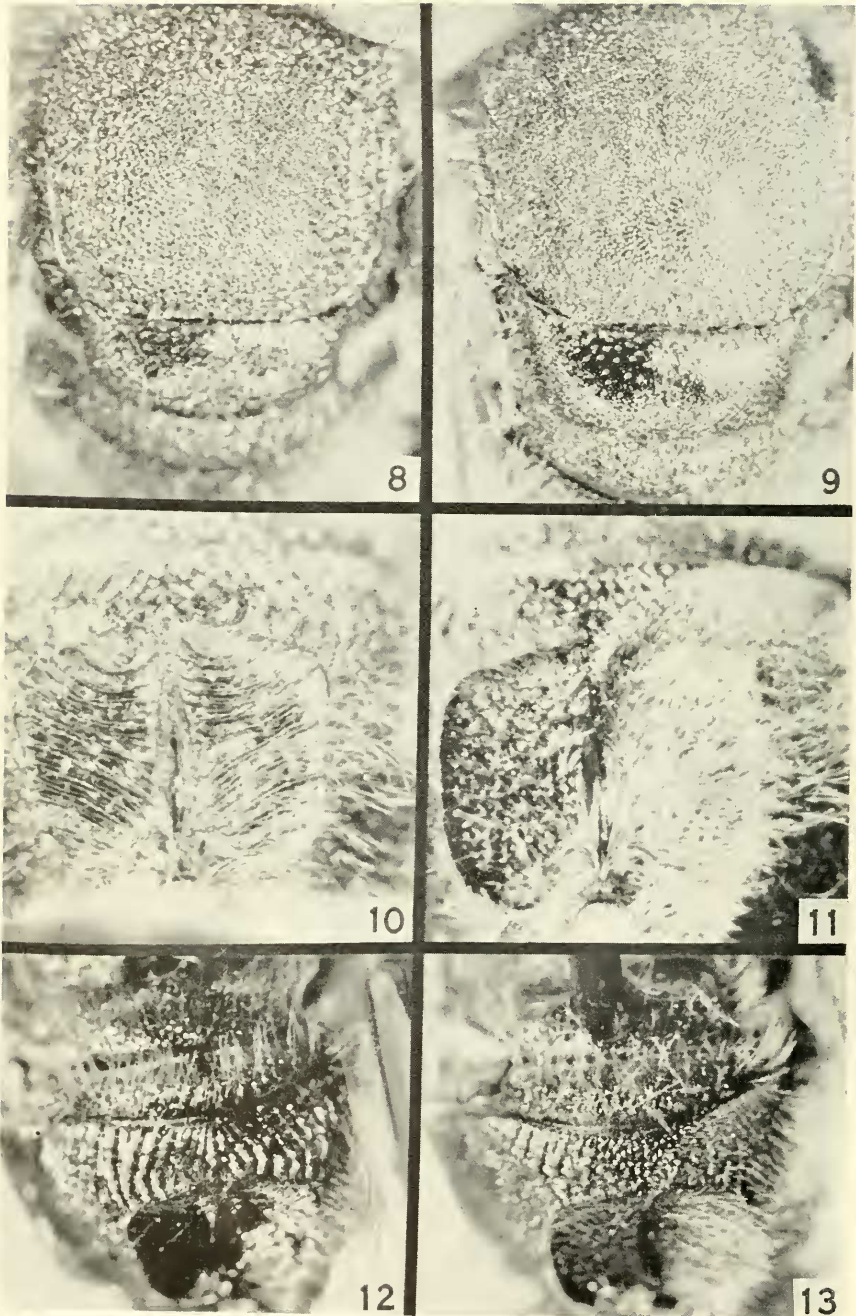
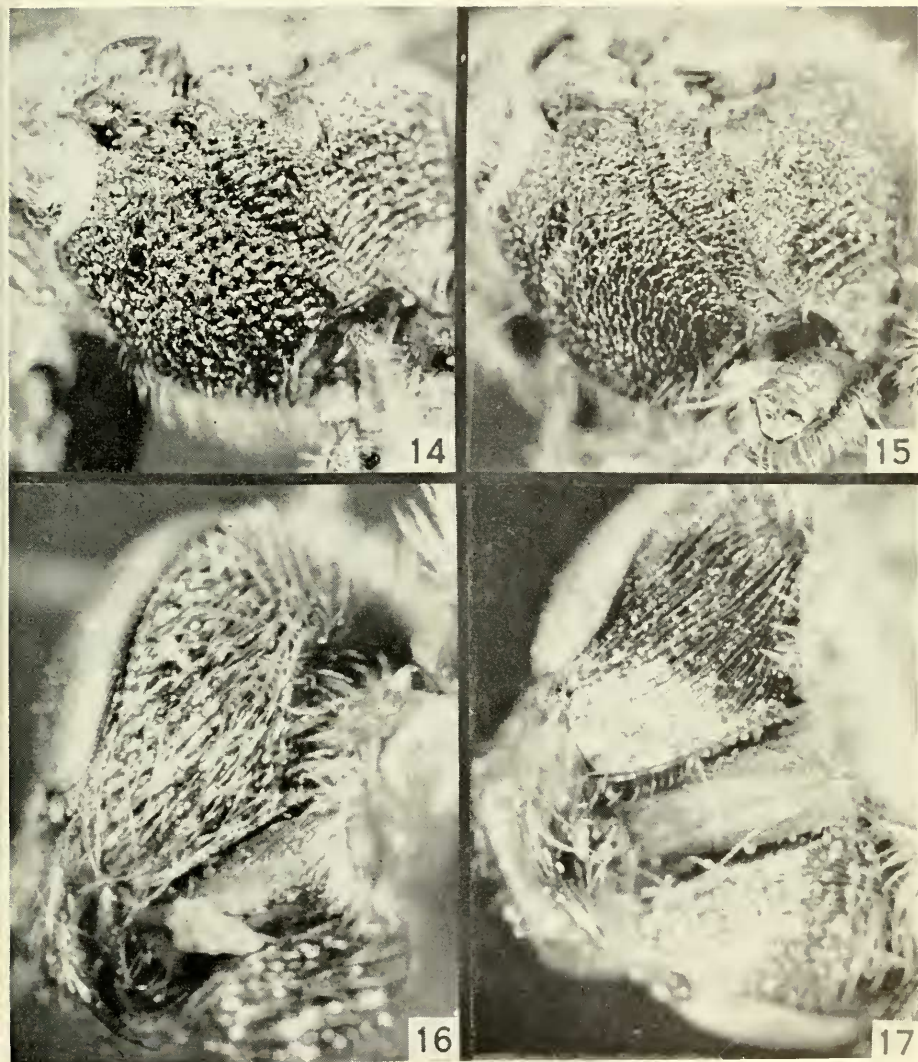


FIG. 7. Distribution of *Agapostemon nasutus* with arrows indicating localities where females with pale amber metasomal terga have been found.



FIGS. 8-13. Coarse sculpturing of *A. poeyi* (left) and finer sculpturing of *A. viequesensis* (right): 8-9, mesonotum; 10-11, propodeal shield; 12-13, dorsal region of propodeum.





FIGS. 14-17. Coarse sculpturing of *A. poeyi* (left) and finer sculpturing of *A. viequesensis* (right): 14-15, lateral view of mesosoma; 16-17, ventral view of genital region.

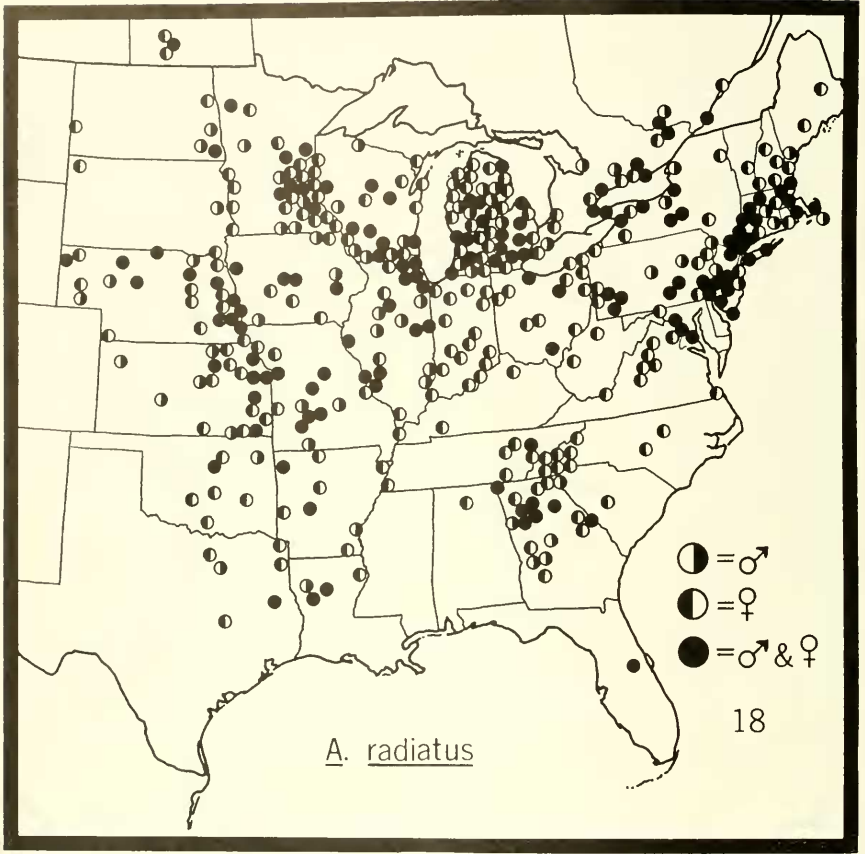


FIG. 18. Distribution of *Agapostemon radiatus*.

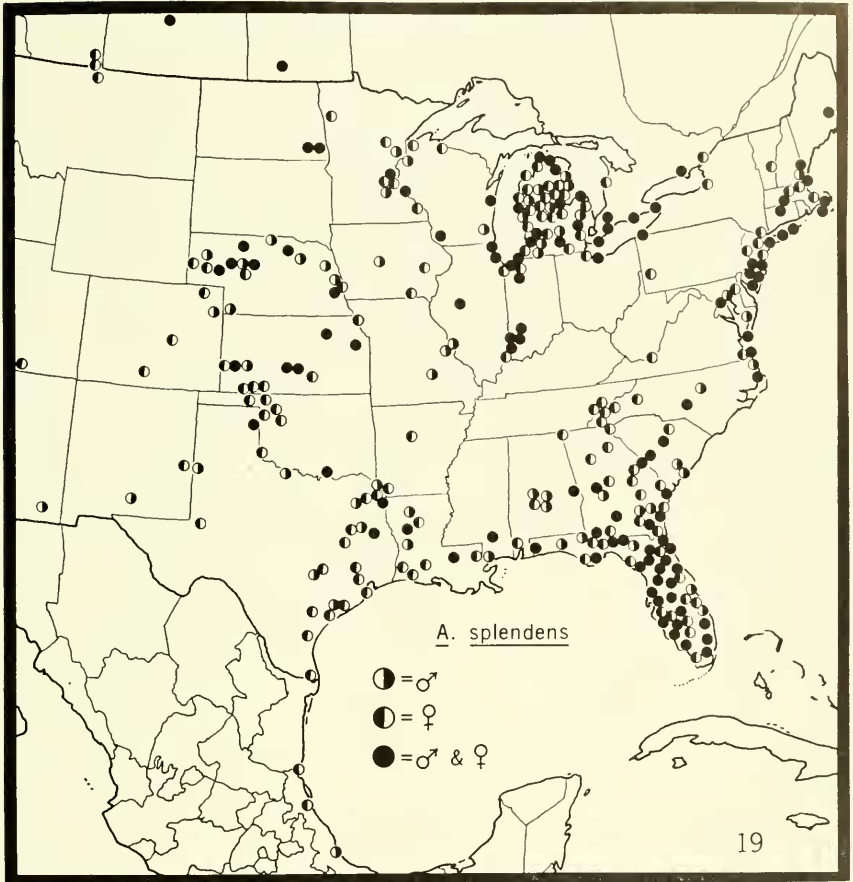


FIG. 19. Distribution of *Agapostemon splendens*.

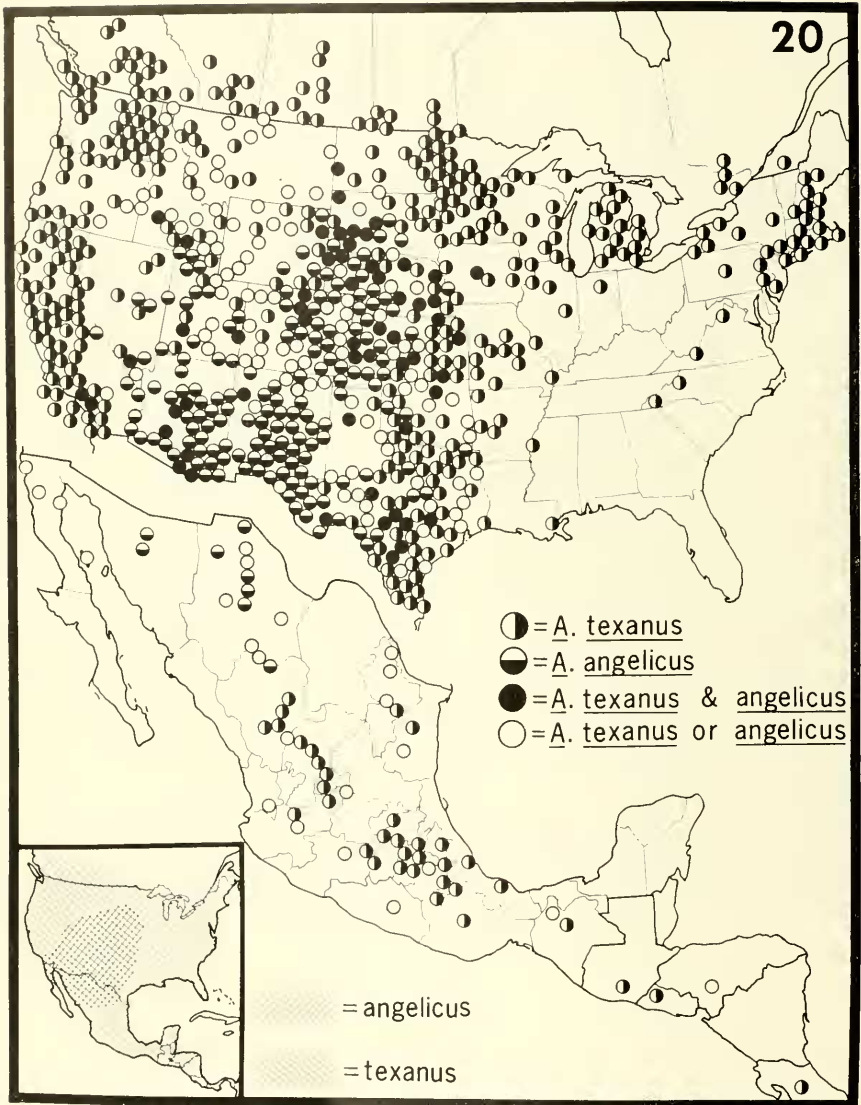
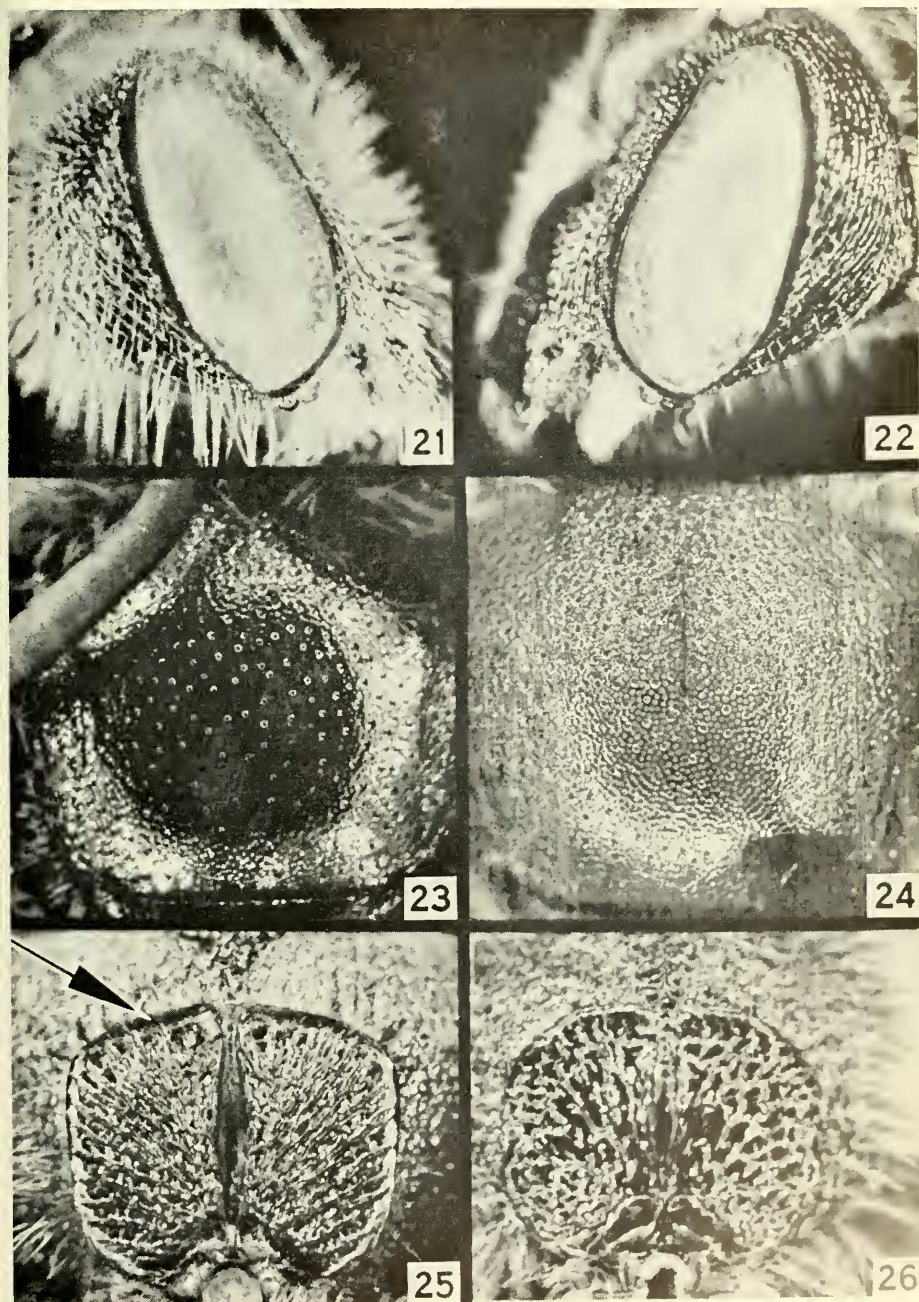


FIG. 20. Map showing distribution of *Agapostemon texanus* males and females (vertically divided circles); *Agapostemon angelicus* males only (horizontally divided circles); *A. texanus* and *A. angelicus* males (black circles); *A. texanus* and/or *A. angelicus* females (open circles).





FIGS. 21-26. *Agapostemon texanus* females: 21-22, head with pubescence, and with pubescence removed; 23-24, variation in mesoscutal punctation; 25-26, variation in propodeal sculpturing. Note propodeal carina (Fig. 25, arrow) characteristic of female *Agapostemon*.



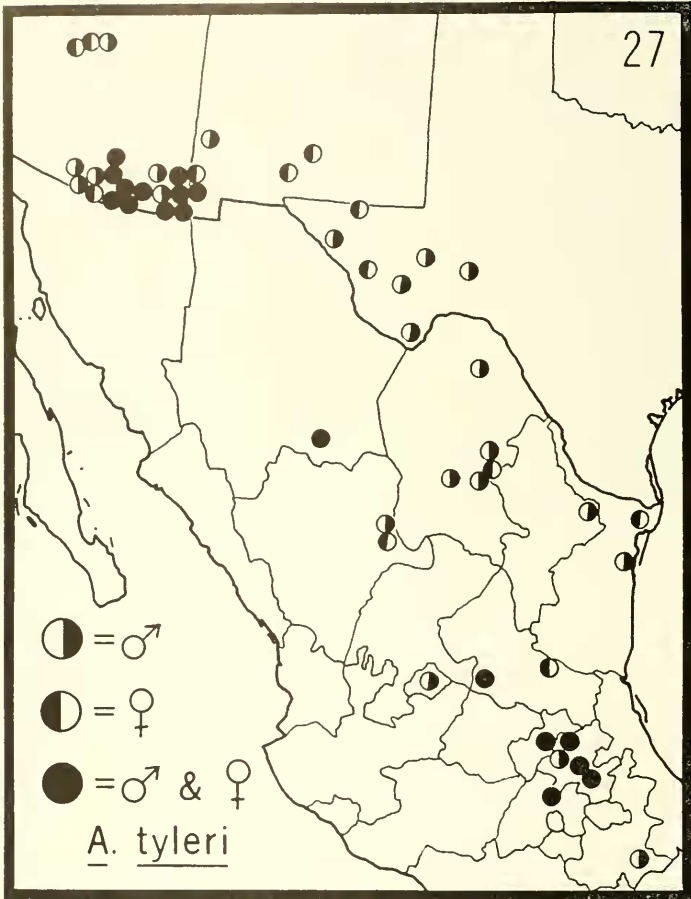
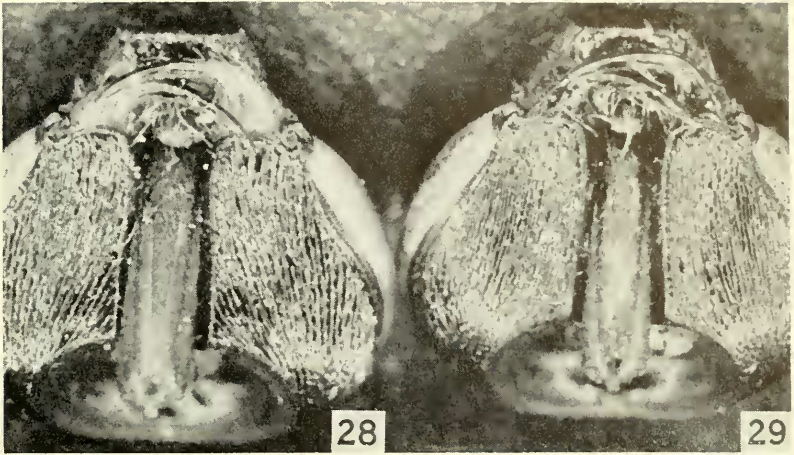


FIG. 27. Distribution of *Agapostemon tyleri*.



FIGS. 28-29. Ventral view of genal region of *Agapostemon virescens* (left) and *A. tyleri* (right).

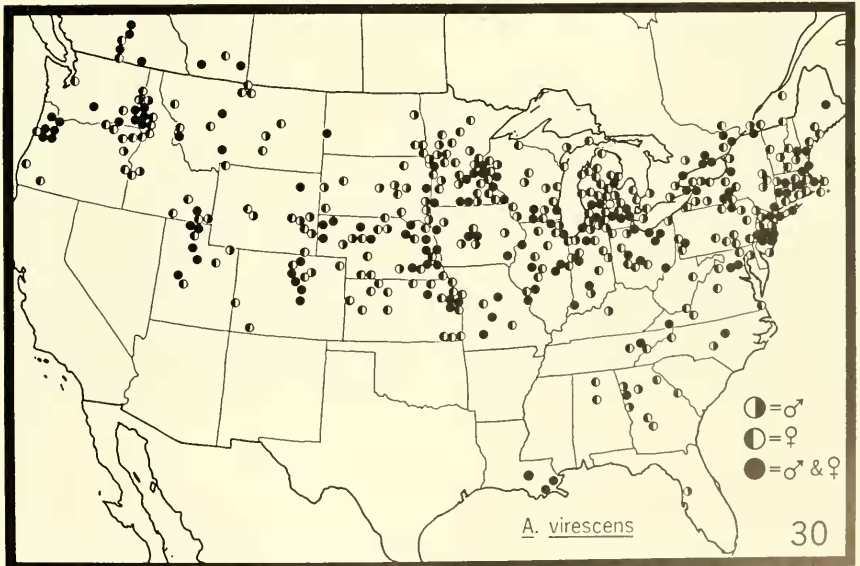
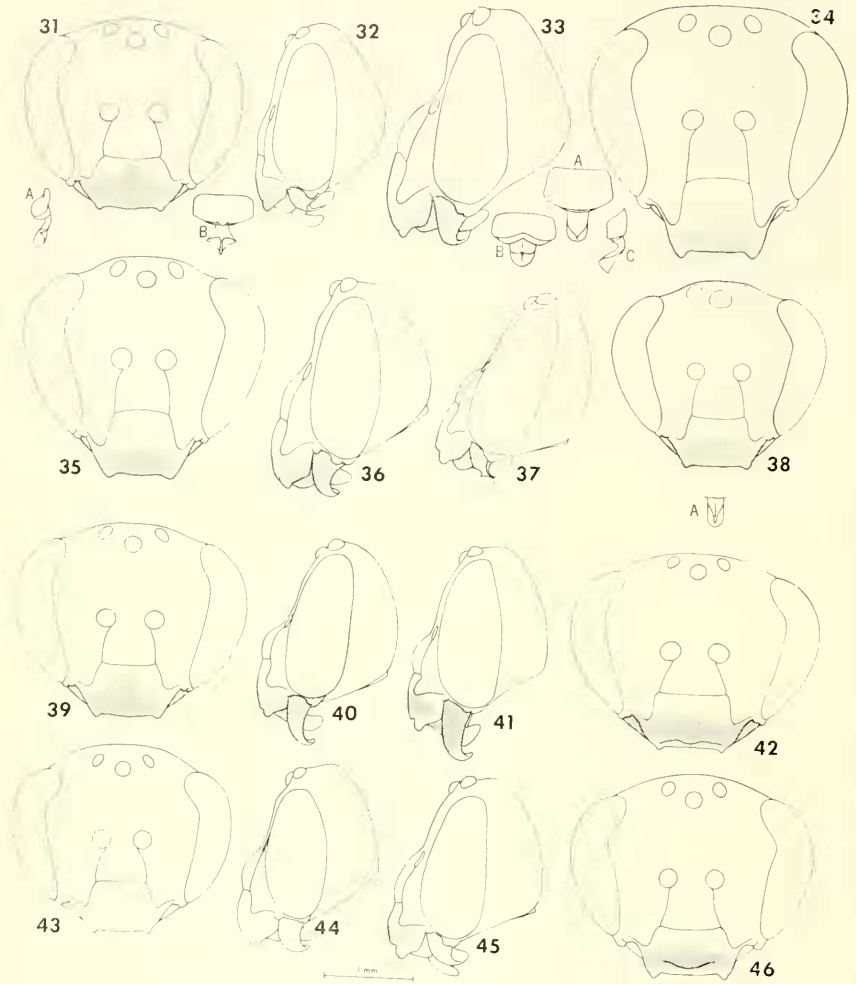
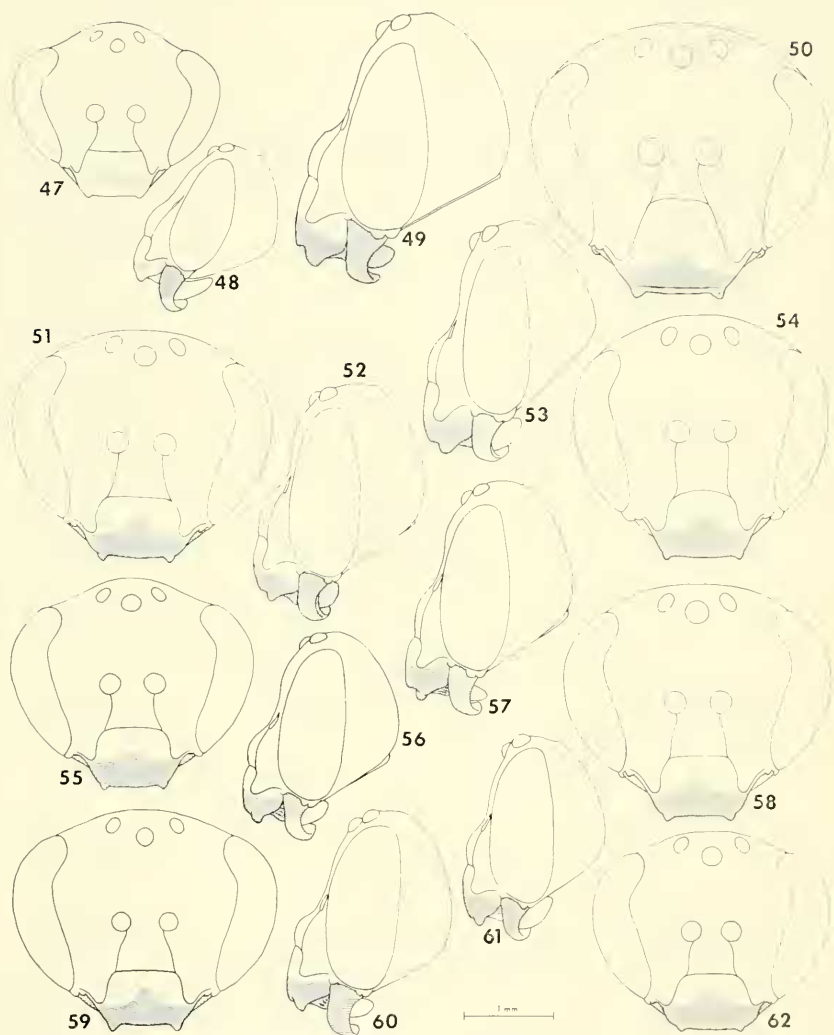


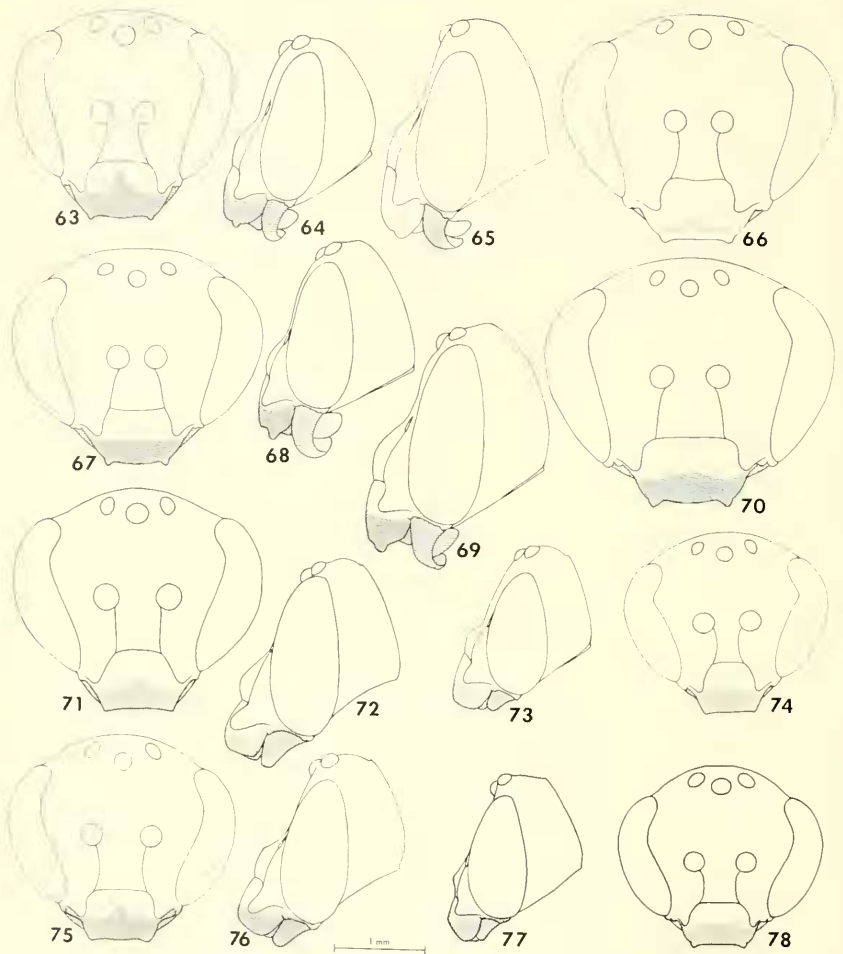
FIG. 30. Distribution of *Agapostemon virescens*.



FIGS. 31-46. Heads of female *Agapostemon* in anterior and lateral views: 31-32, *A. kohliellus* (stippling yellow) with lateral (A) and anterior (B) views of labrum; 33-34, *A. viridulus* (stippling brown) with anterior (A), antero-distal (B) and lateral (C) views of labrum; 35-36, *A. swainsonae* (stippling amber); 37-38, *A. hispaniolicus* (stippling brown) with anterior view (A) of apex of labrum; 39-40, *A. viequesensis* (stippling brown); 41-42, *A. nasutus* (stippling yellow); 43-44, *A. atrocaeruleus*; 45-46, *A. leunculus* (stippling yellow).



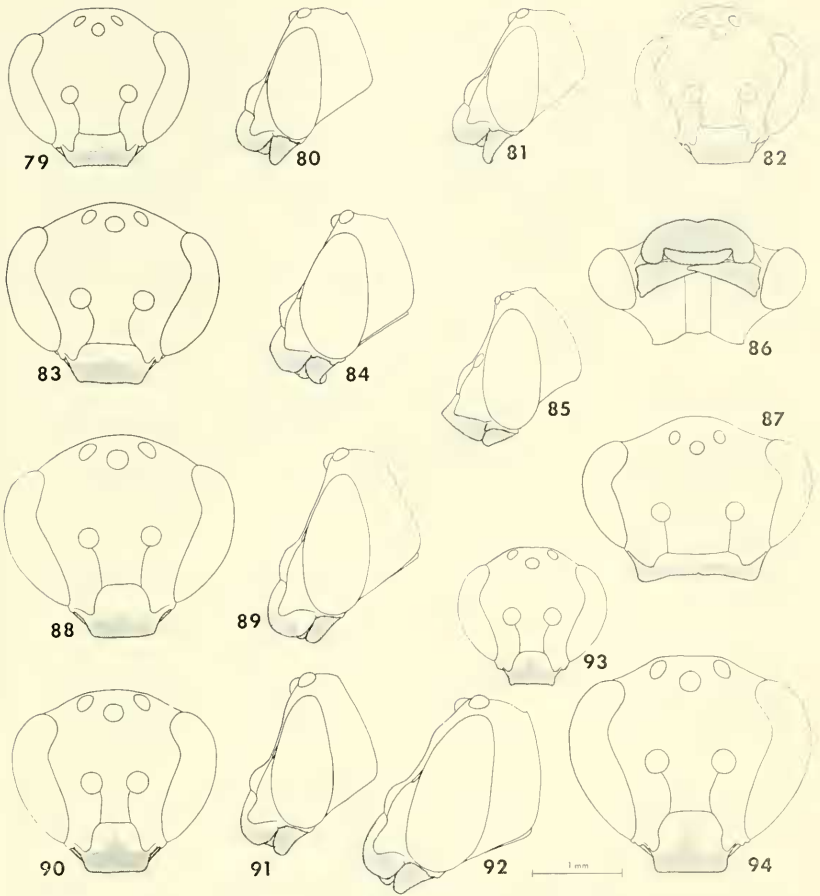
FIGS. 47-62. Heads of female *Agapostemon* in anterior and lateral views: 47-48, *A. intermedius* (stippling yellow); 49-50, *A. coloradinus* (stippling brown-black); 51-52, *A. tyleri* (stippling brown-black); 53-54, *A. virescens* (stippling brown-black, hatching yellow); 55-56, *A. radiatus* (stippling black, hatching yellow); 57-58, *A. femoratus* (stippling black, hatching orange); 59-60, *A. cockerelli* (stippling black, hatching yellow); 61-62, *A. melliventris* (stippling yellow).



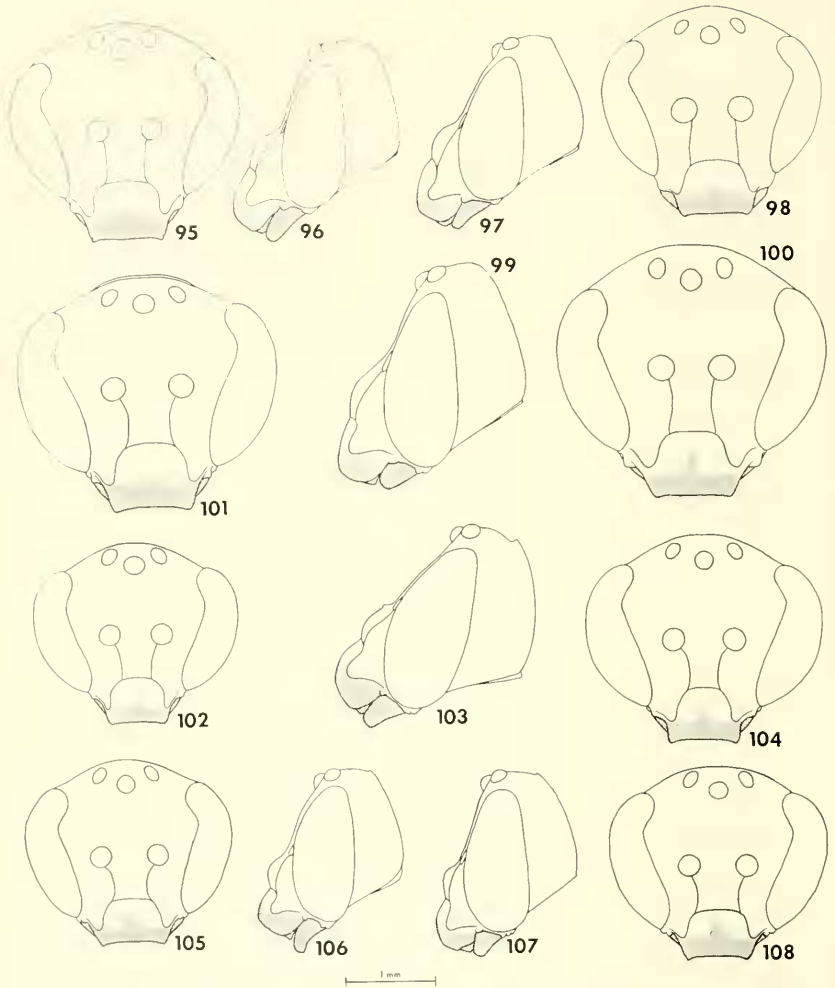
FIGS. 63-70. Heads of female *Agapostemon* in anterior and lateral views: 63-64, *A. mexicanus* (stippling amber, hatching yellow); 65-66, *A. peninsularis* (stippling yellow); 67-68, *A. texanus* or *A. angelicus* (stippling black, hatching yellow); 69-70, *A. splendens* (stippling brown-black, hatching amber).

FIGS. 71-78. Heads of male *Agapostemon* in anterior and lateral views (stippling yellow): 71-72, *A. splendens*; 73-74, *A. angelicus*; 75-76, *A. texanus*; 77-78, *A. rhopalocera*.

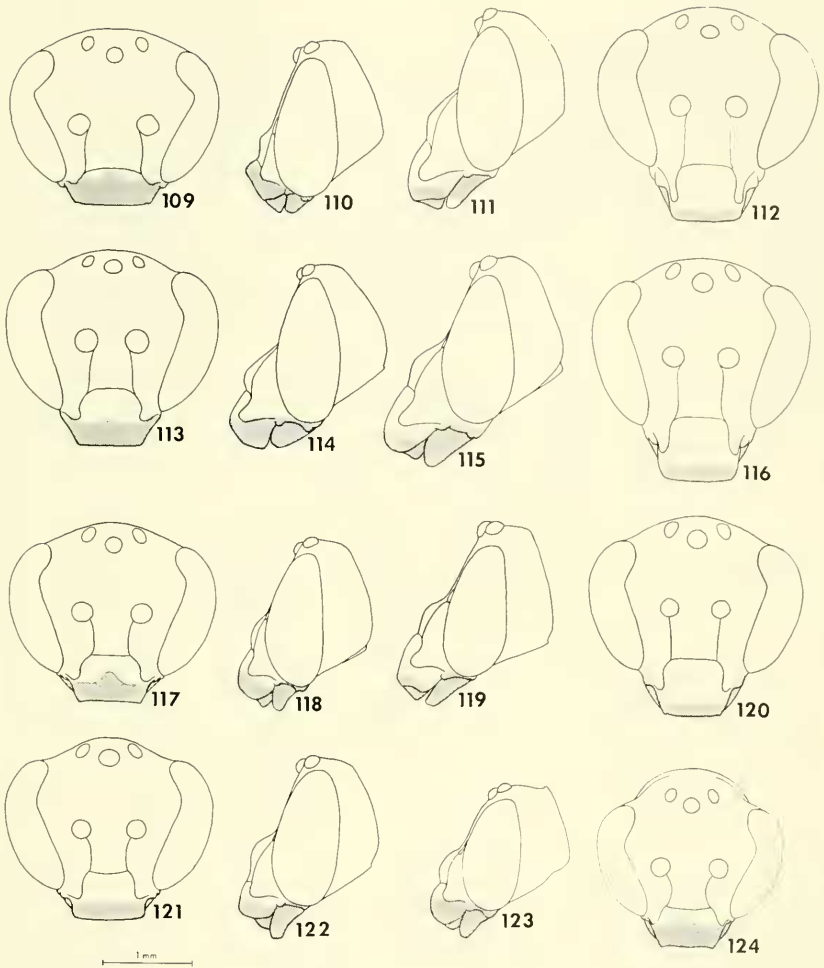




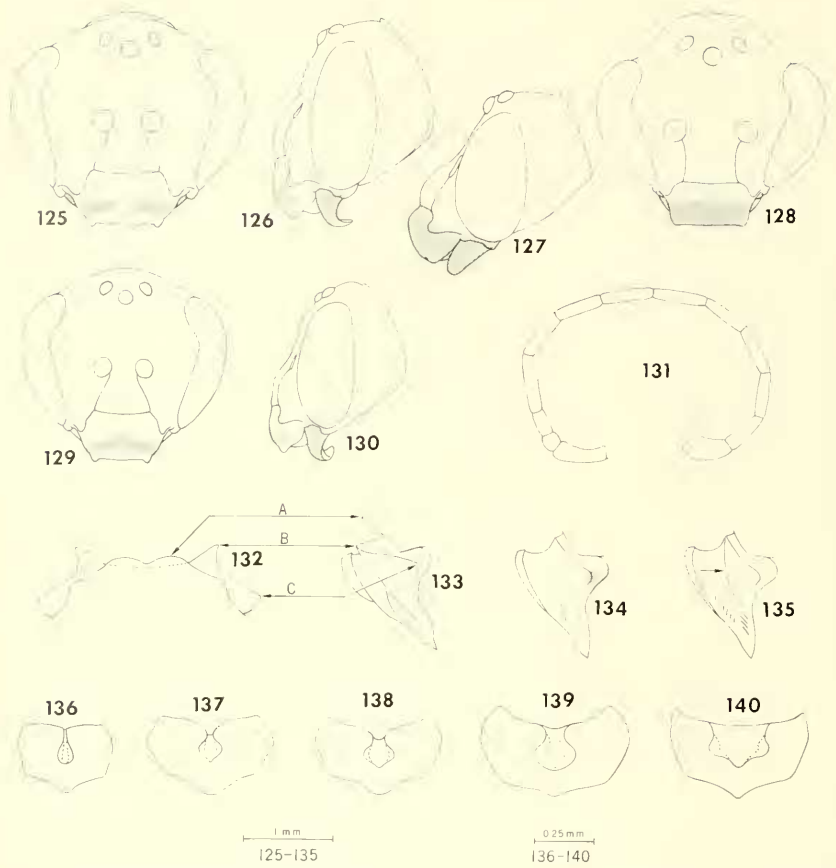
FIGS. 79-94. Heads of male *Agapostemon* in anterior and lateral views (Fig. 86, ventral view): 79-80, *A. atrocaeruleus*; 81-82, *A. intermedius*; 83-84, *A. leunculus*; 85-87, *A. nasutus*; 88-89, *A. peninsularis*; 90-91, *A. mexicanus*; 92-94, *A. melliventris* (note size variation of two specimens, 93-94, collected at the same time and place). Yellow or creamy maculations are indicated with stippling.



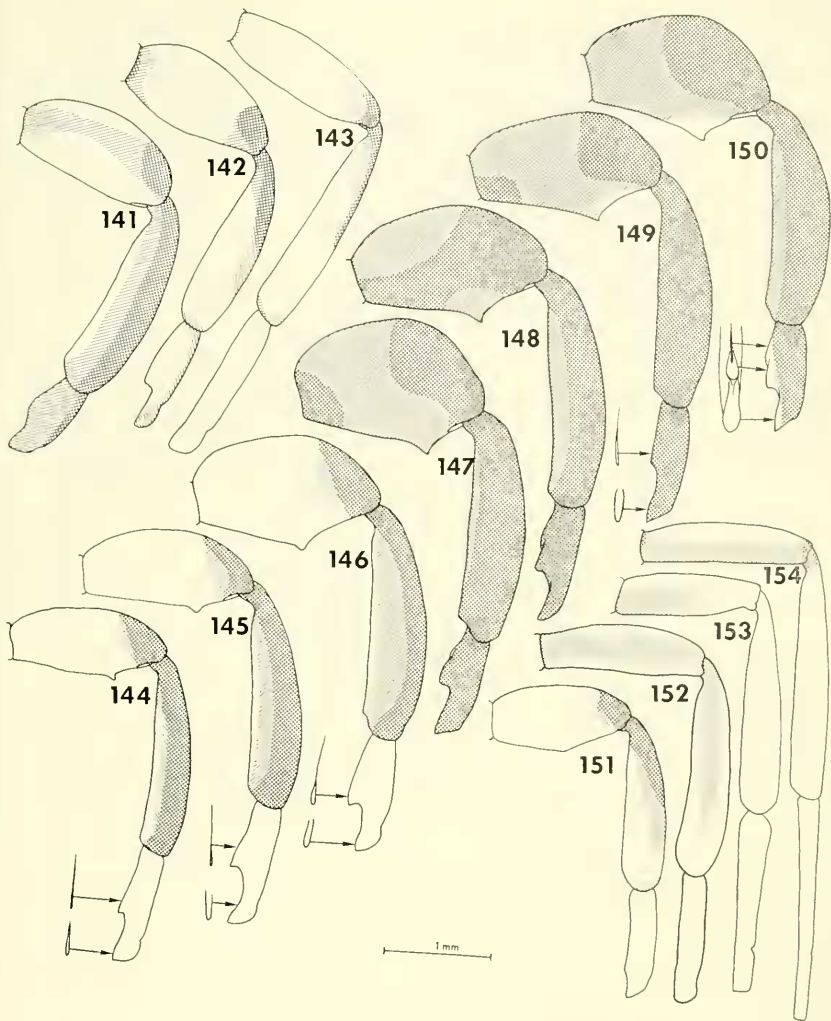
FIGS. 95-108. Heads of male *Agapostemon* in anterior and lateral views: 95-96, *A. tyleri*; 97-98, *A. virescens*; 99-100, *A. coloradinus*; 101-104, *A. femoratus* (note size variation, 101-102); 105-106, *A. radiatus*; 107-108, *A. cockerelli*. Yellow or creamy maculations are indicated with stippling.



FIGS. 109-124. Heads of male *Agapostemon* in anterior and lateral views: 109-110, *A. kohliellus*; 111-112, *A. viridulus*; 113-114, *A. swainsonae*; 115-116, *A. hispaniolicus*; 117-118, *A. viequesensis*; 119-120, *A. cubensis*; 121-122, *A. centratus*; 123-124, *A. semimelleus*. Yellow or creamy maculations are indicated with stippling.

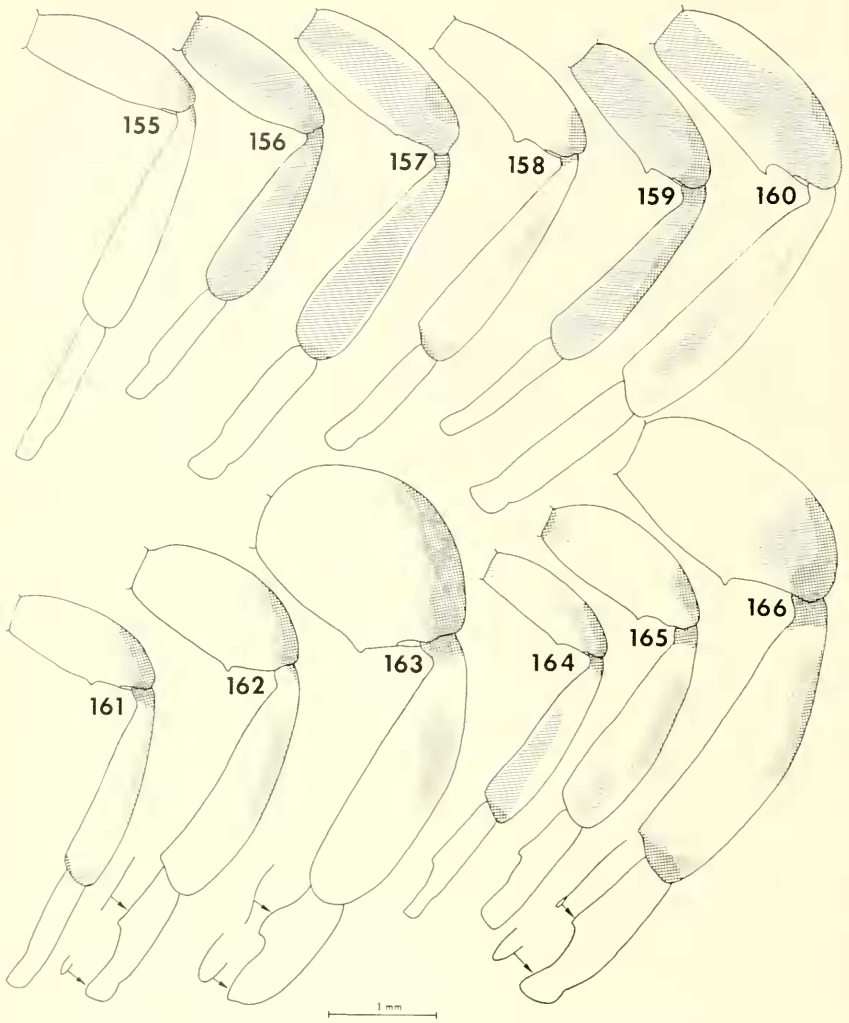


FIGS. 125-140. 125-130, heads of *Agapostemon* in anterior and lateral views, with yellow maculations stippled: 125-126, *A. mourei* female; 127-128, *A. mourei* male; 129-130, *A. semi-melleus* female; 131, dorsal view of *A. rhopalocera* male right antenna; 132-133, dorsal and lateral views of male *A. mourei* pronotum showing overlapping mesoscutum (A), acute lateral angle (B), and angular posterior lobe (C); 134, lateral view of female *A. nasutus* pronotum showing yellow maculation (stippling); 135, lateral view of female *A. leuculus* pronotum showing carina (arrow) not found on *A. nasutus*; 136-140, last visible (6th) male sternites: 136, *A. intermedius*; 137, *A. boliviensis*; 138, *A. lanosus*; 139, *A. mourei*; 140, *A. inca*.

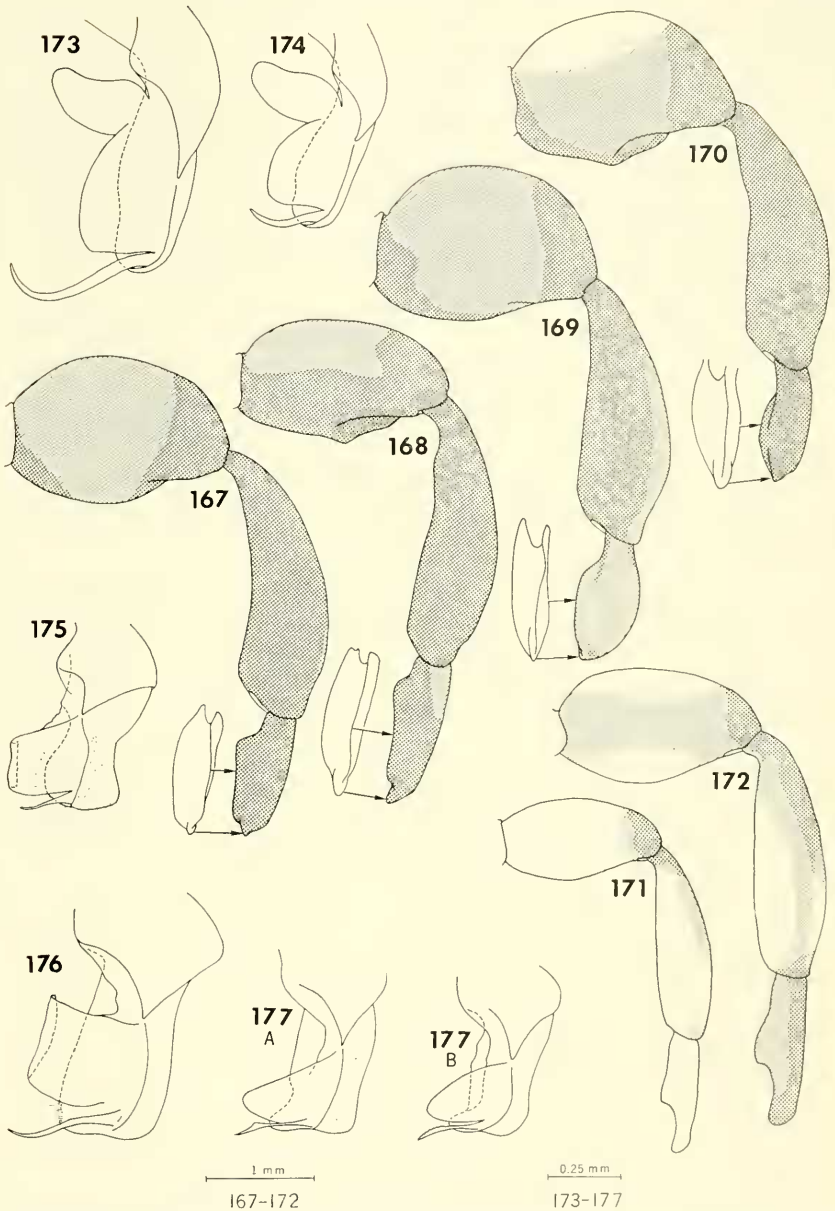


FIGS. 141-154. Anterior views of male *Agapostemon* hind femur, tibia and basitarsus. Color yellow or creamy with brown or black maculations. Anterior maculations with left oblique or vertical hatching; posterior maculations with right oblique or horizontal hatching; anterior and posterior maculations with cross hatching. 141, *A. kolliellus*; 142, *A. atrocaeruleus*; 143, *A. leunculus*; 144, *A. poeyi*; 145, *A. viequesensis*; 146, *A. jamaicensis*; 147, *A. swainsonae*; 148, *A. hispaniolicus*; 149, *A. cubensis*; 150, *A. viridulus*; 151, *A. intermedius*; 152, *A. centratus*; 153, *A. nasutus*; 154, *A. rhopalocera*. Arrows indicate ventral views of basal ridge and apical groove on basitarsus.



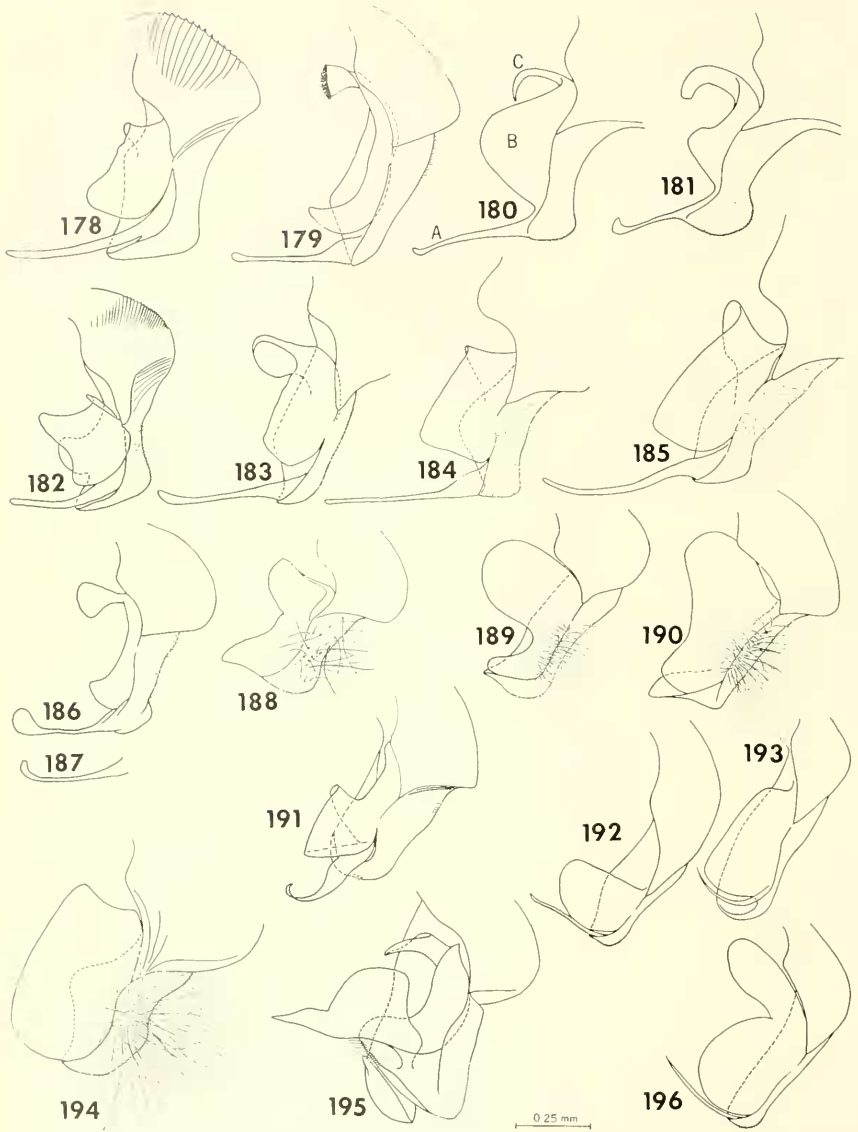


Figs. 155-166. Anterior views of male *Agapostemon* hind femur, tibia, basitarsus. Color yellow or creamy with brown or black maculations. Anterior maculations with vertical hatching; posterior maculations with horizontal hatching; anterior and posterior maculations with cross hatching. 155, *A. melliventris*; 156, *A. mexicanus*; 157, *A. peninsularis*; 158, *A. virescens*; 159, *A. tyleri*; 160, *A. coloradinus*; 161, *A. radiatus*; 162, *A. cockerelli*; 163, *A. femoratus*; 164, *A. angelicus*; 165, *A. texanus*; 166, *A. splendens*. Arrows indicate ventral views of basal ridge and apical groove on basitarsus.

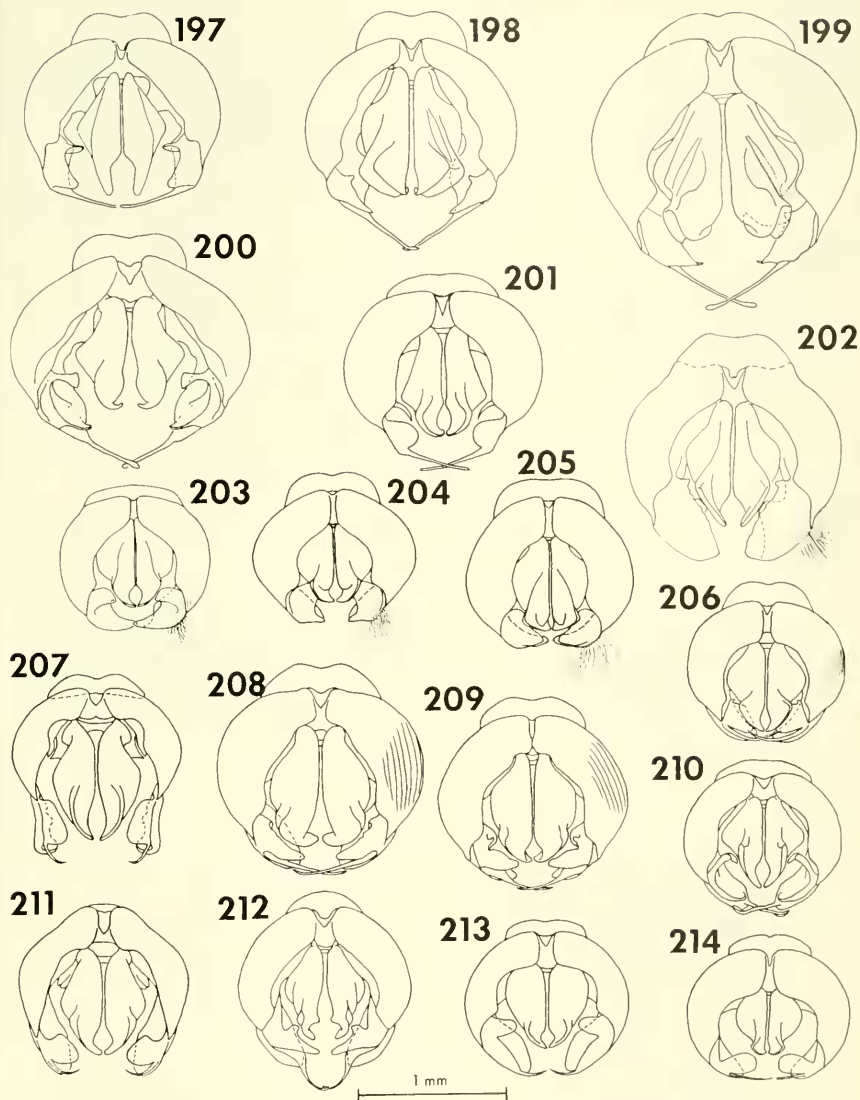


FIGS. 167-172. Anterior views of male *Agapostemon* hind femur, tibia, basitarsus. Color yellow or creamy with brown or black maculations. Anterior maculations with left oblique hatching; posterior maculations with right oblique hatching; anterior and posterior maculations with cross hatching. 167, *A. mourei*; 168, *A. inca*; 169, *A. lanosus*; 170, *A. boliviensis*; 171, *A. semimelleus*; 172, *A. chapadensis*. Arrows indicate ventral views of basal ridge and apical groove on basitarsus.

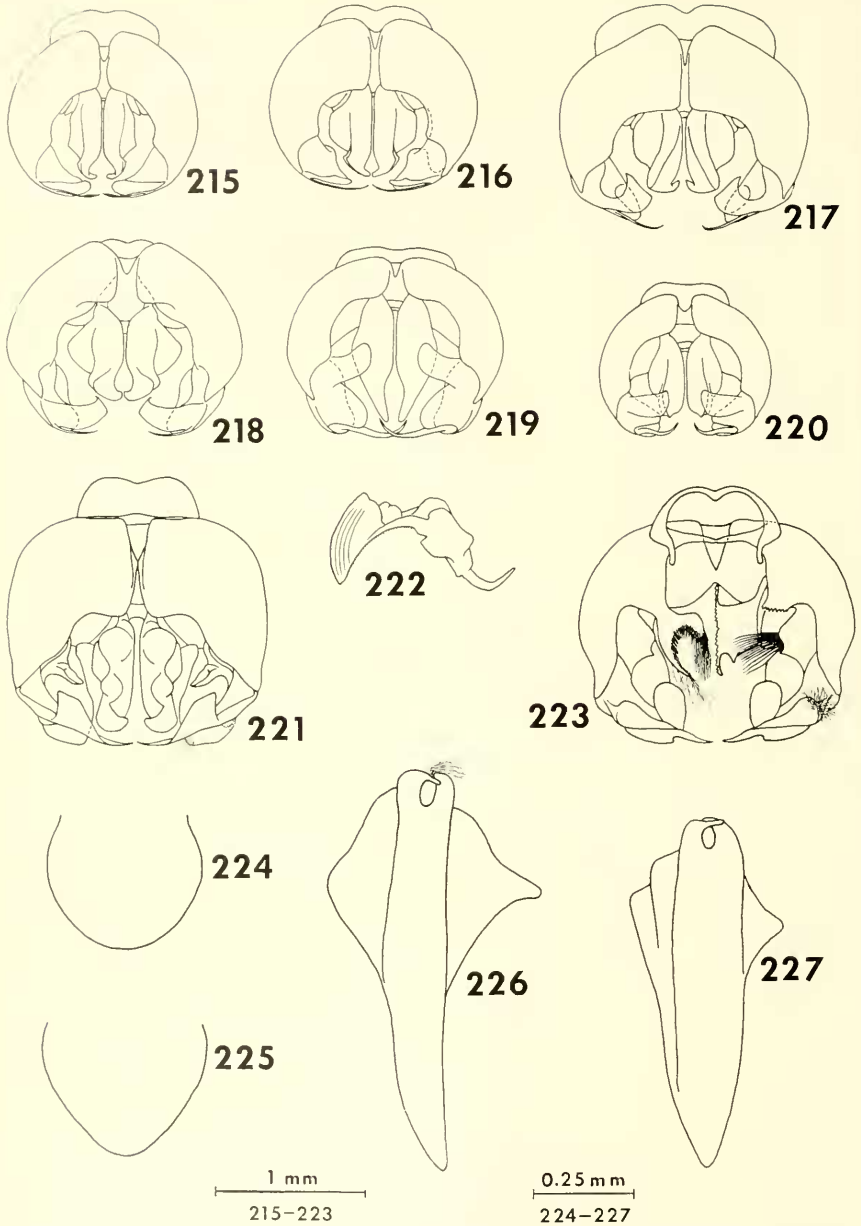
FIGS. 173-177. Apical view of male gonostyli (right side): 173, *A. chapadensis*; 174, *A. semimelleus*; 175, *A. inca*; 176, *A. mourei*; 177A, *A. boliviensis*; 177B, *A. lanosus*,



FIGS. 178-196. Apical view of male gonostyli (right side): 178, *Agapostemon viridulus*; 179, *A. splendens*; 180, *A. texanus* (A, apical stylus; B, medial plate; C, basal stylus); 181, *A. angelicus*; 182, *A. centratus*; 183, *A. virescens*; 184, *A. tyleri*; 185, *A. coloradinus*; 186, *A. poeyi*; 187, *A. viequesensis*; 188, *A. melliventris*; 189, *A. mexicanus*; 190, *A. peninsularis*; 191, *A. kohlicellus*; 192, *A. intermedius*; 193, *A. leunculus*; 194, *A. femoratus*; 195, *A. nasutus*; 196, *A. atrocaeruleus*.



FIGS. 197-214. Dorsal view of male genitalia (showing striae and pubescence on right side only): 197, *Agapostemon virescens*; 198, *A. tyleri*; 199, *A. coloradinus*; 200, *A. splendens*; 201, *A. texanus*; 202, *A. femoratus*; 203, *A. melliventris*; 204, *A. mexicanus*; 205, *A. peninsularis*; 206, *A. centratus*; 207, *A. rhopalocera*; 208, *A. viridulus*; 209, *A. swainsonae*; 210, *A. poeyi*; 211, *A. leunculus*; 212, *A. kohliellus*; 213, *A. atrocaeruleus*; 214, *A. intermedius*.



FIGS. 215-227. 215-221, dorsal view of male genitalia: 215, *A. boliviensis*; 216, *A. lanosus*; 217, *A. mourei*; 218, *A. inca*; 219, *A. chapadensis*; 220, *A. semimelleus*; 221, *A. nasutus*; 222, lateral view of right penis valve of *A. nasutus*; 223, ventral view of male genitalia of *A. nasutus* (ventral flap removed on right); 224, posterior view of *A. viequesensis* male pygidium; 225, posterior view of *A. ochromops* male pygidium; 226, distal view of *A. coloradinus* right penis valve; 227, distal view of *A. tyleri* right penis valve.



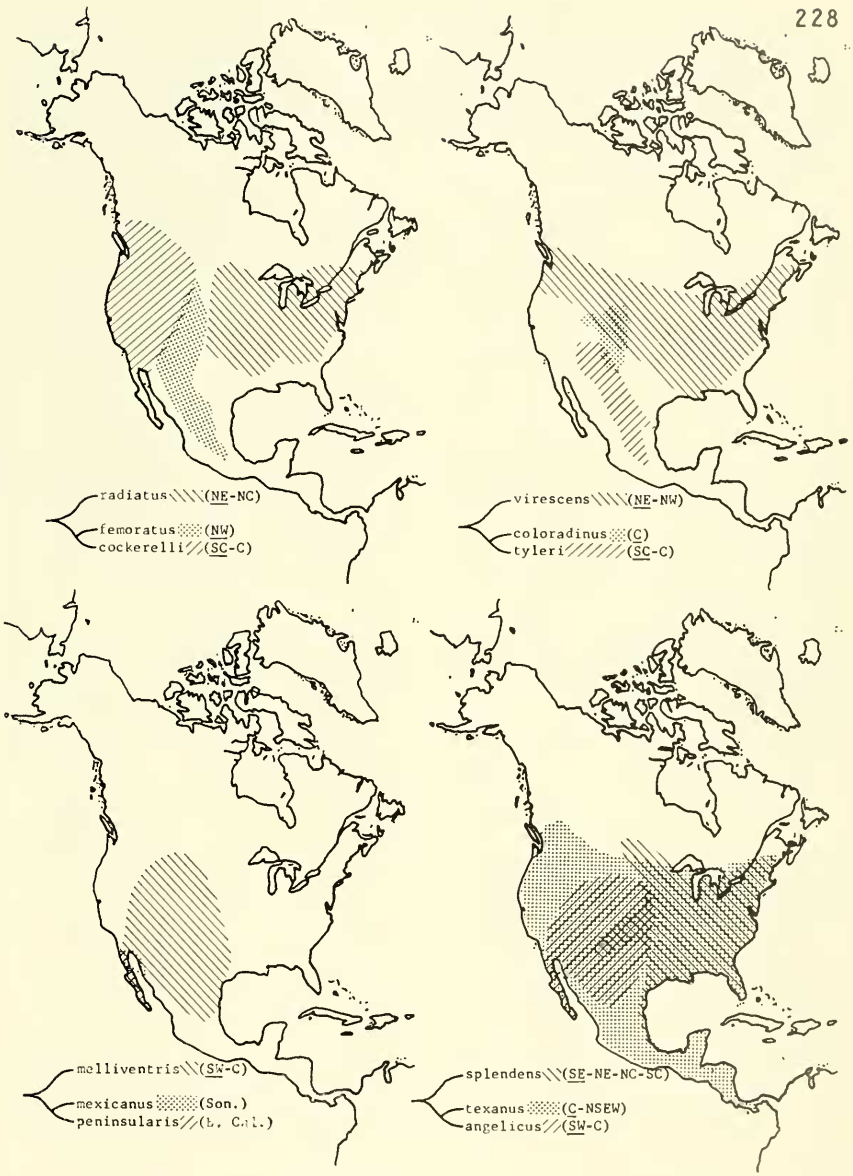


FIG. 228. Distribution maps of the four North American species groups. The dendrograms indicate phenetic and presumed cladistic relationships within each species group.

## INDEX TO INCLUDED TAXA

Valid *Agapostemon* species are in boldface. When different from current generic placement, the original genus of description is preceded by a semicolon. Page numbers are in boldface for descriptions or synonymies and in italics for illustrations.

- abjectus* Cockerell, *Agapostemon obscuratus*, 513.  
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